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ELECTRICAL WORLD AND ENGINEER.

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CABLES AND COHERERS.

Those who have attended the dispatch of wireless telegraph messages across the Atlantic have described the use of wool in the ears in order to deaden the sound caused by the disruptive discharge across the gap, that sets the ether in a tingle and might burst an ear drum, so violent is the shock to the auditory organs. According to the wireless advocates this plugging of the ears with wool has been characteristic also of cable managers in regard to the news of wireless work; and we do not think they are likely to find much material for sympathetic comment in the remarks of Mr. George Gray Ward at the annual meeting of the Commercial Cable interests. That veteran cable manager maintained his cheery and optimistic attitude in addressing the stockholders and said: "Nothing has occurred since I last addressed you to cause us to modify the conservative estimate then expressed, and which I confidently repeat, that telegraphy by means of wires has little to fear from the competition of telegraphy without wires. For the benefit of those who do not share my confidence, I may say that the etheric waves will be as obedient to us as to anybody if it should ever be found practicable to dispense with cables and wires." In fact, Mr. Ward fears neither wireless nor wireful competition, but if necessary is ready to do without wires as well as anybody else.

By one of those coincidences of which all history is full, it happened that just as Mr. Ward was standing up for cables, the first cable should be abandoned for wireless methods within view of the room where he was speaking—namely, the government cable from Fort Wadsworth across the harbor to Sandy Hook. Not much of a stretch, perhaps, but still a cable, lying where some of the earliest cablework in this country was done. As a matter of fact, the claim for the first supersession of cable by wireless might be made for the Guadeloupe-Martinique service, where the volcanic eruptions have broken all the cables, sunk the cable ship and rendered the wireless essential for communication. Possibly the cable may be renewed there, but West Indian lines have always been a nuisance in the way of frequent interruptions, whereas the lineman's job on a wireless system is easy.

MUNICIPAL TELEPHONY.

One of the papers presented at the recent municipal ownership convention in New York City, on the subject of municipal telephony in Great Britain, by Mr. A. R. Bennett, betrayed an extraordinary absence of financial common sense. And yet the word extraordinary seems rather out of place when we consider how common is the tendency of advocates and statisticians for municipal ownership to leave depreciation out of their estimates. In speaking of the Glasgow system and its financial year, Mr. Bennett remarks naively: "No depreciation was allowed for because the system was entirely new." As if conscious that something is wrong, he goes on to say that a depreciation fund is to be created. The notion here exhibited as to the nature of depreciation and the purposes of a depreciation fund does not give much weight to any of Mr. Bennett's other statements, which but for it might possibly be entertained with respect. But it is easy to see how remarkable municipal economies may be arrived at by such free treatment of unavoidable items in the cost of telephone service. Only a week or two ago we had occasion to point out in regard to the electric lighting plant at Detroit that not merely did the Commissioners fix a very small rate of depreciation, say 3

per cent., but they did not take into account the wholesale depreciation due to the substitution of new apparatus for old. This criticism is just as true of telephone exchanges in large cities, which are replaced once or twice in every decade, as in New York, for example.

Speaking of New York, reminds us that in his reference to the sale of the municipal telephone exchange at Tunbridge Wells, Mr. Bennett says: "The transaction has been denounced as the first Tammany operation in Great Britain." What a funny idea of Tammany to foist on pretty, classic little Tunbridge Wells! The Tammany plan is to municipalize everything, so as to handle more public money and dispose of more offices and votes. "Prof." Frank Parsons, in discussing the same subject under the title, "Reasons for Public Ownership of the Telephone," sees the danger lurking in any allusion to Tammany, and argues that if a municipal plant is run corruptly, it is, therefore, not under municipal control; while if it is well run, then it really is under municipal control. To quote his own words in regard to Philadelphia: "Public ownership of the government is essential to any real public ownership of anything else. We are told, for example, that the gas works of Philadelphia were allowed to get out of repair under public ownership. But the truth is that Philadelphia did not have public ownership of the gas works any more than Russia has public ownership of her railways. The essence of ownership is control, and the Philadelphia gas works were controlled by the councils, and the councils were controlled by the corporations," etc., etc. In other words, any municipal plant that fails is not municipally owned; with the corollary that "city councils" ready to make vicious deals with corporations, are angels of light when operating public utilities that will yield more to the councilor or aldermen if not sold out. We don't quite follow Mr. Parsons, but still we have long been expecting an ingenious scheme for disclaiming municipal failures. Here it is.

PROCEEDINGS OF THE A. A. A. S.

The volume of *Proceedings* of the American Association for the Advancement of Science at the Pittsburg meeting in July, 1902, is just out. It contains 620 pages, a number of interesting and important addresses, and some grievous faults. In the first place, the pages are uncut, which is barbarous anachronism. It is not presumptuous to suppose that this volume is intended to be opened and read by scientific men. These men are virtually expected to spend their time cutting pages, a task that could be much better performed by the binder's machine, at no appreciable extra cost. In the second place, no less than 263 pages, or about 42 per cent. of the volume, is trivially occupied in a catalogue of membership. It is well to know that there were 3,474 members of all classes on the roster of the association. It is not well, however, to occupy nearly half the volume of proceedings with the list. Members' names are of far less scientific importance for publications than their papers. In the third place, the published papers in the working half of the volume are limited to the addresses of the retiring president and of the vice-presidents of Sections A, B, D, E, F, G, H and I. In a certain sense these official addresses are functions rather than papers. The only real paper comes squeezed into an appendix at the end of the volume.

Taking Section B on Physics, the subject in which the readers of this journal take most interest, it appears that 58 papers were communicated to the meeting in the Physical Section. Of these, 25, or 43 per cent., were on subjects connected with electricity and magnetism. No publication is given of these papers beyond their titles. It is like the list of a horse-race after the first leaders—"also ran." Twelve of the papers have been rescued and published, seven of them finding record in the *Physical Review*. The other titles are virtually "Hic jacet"'s. Eighty per cent. of the papers in Section B have been put to death. Verily, the A. A. A. S. should be called the Association for the Abortion of Additions to Science. Even assuming that all the members of the association attended the meeting, and that all the members of this section listened to the communications, the permanent value of the papers would be enormously increased by printing and publication. It may be urged that the expense of printing all these papers would be prohibitive. For the association itself, this might be true; but at least the wasted half of the proceedings now occupied by membership might be utilized to advantage by keeping the list of members at home, and publishing some of the papers instead. Then, an organized effort should be made to interest the technical press of the country in printing at least an abstract of the remainder. But in the past there has appeared to be an organized resistance to the efforts made by the technical press to obtain a report of meetings. This heartless murder of innocents ought to be stopped. It is an insult to the writer of a paper to invite him to read it, and then deliberately to bury it and put up a headstone to its untimely demise. The remedy for this deplorable situation appears to us not difficult to discover or to apply. As we have repeatedly pointed out, the unsatisfactory state of affairs is largely due to the absence of a permanent secretariat such as those of the national professional organizations. A result of this condition is that the Association is entirely lacking in business management, there is no proper preliminary preparation for meetings and at meetings no facilities are provided for those who would report the papers and discussions. At times it has seemed that attempts to give prompt publicity to the proceedings were resented, but we believe such a suspicion unjust, the want of encouragement to such efforts being most probably due rather to sheer inability to appreciate what the real function and influence of a body purporting to represent American science should be. Next to a permanent secretariat would be the constitution of an active governing body, the members to consist of men of proven administrative capacity, such as college presidents, with long and overlapping terms of office.

SCIENCE ABSTRACTS.

It is interesting to observe that our friend and contemporary, *Science Abstracts*, after five years of life, has multiplied by cross-division, and assumed a dual existence, like an adult bacterium. It is now issued in two sections like an overgrown railway train. The first section is marked A and devoted to physics or basic science. The second section is marked B and is devoted to engineering or applied science. The plan is likely to meet with general favor, and has taken effect from and with the January number this year. The color of our friends is as vehement as ever, and puts all neighboring objects to the blush. Surely, the tint of one of the recent twin sisters might be subdued a little with advantage, if only for the purpose of readily distinguishing them. Otherwise we shall have to use ribbons of different hues, according to the time-honored geminate custom.

SPARKS AND SHOCKS FROM INSULATED WIRES.

In the recently issued No. 159, of the *Journal* of the British Institution of Electrical Engineers, is a short paper read by Mr. F. Gill, before the Dublin Local Section on a remarkable hydro-electric phenomenon. It appears that one of the linemen of the National Telephone Company was at work on a pole carrying 17 overhead wires running through a rural district near Glasgow. He reported that on touching the topmost wire he received a severe electric shock. On investigating the matter, a member of the engineering staff of the company ascertained that sparks could at certain times be drawn from this wire. The wire was about half a mile long, of copper,

about No. 12 B. & S. gauge, insulated and dead-ended at each end. Nevertheless this dead wire was at times very much alive. The height of the wire above the ground was 26 feet, and its total capacity about 0.0087 microfarad. The remarkable phenomenon was traced to the exhaust steam from a colliery engine. The exhaust pipe extended to a height of 18 feet, with a diameter of three inches at the top. The top of the pipe was, therefore, about 8 feet lower than the wire, and about 23 feet away. On a dry day, when the wind blew the exhaust steam from the top of the pipe against the wires, a hydro-electric charge was communicated to them. The topmost wire, being insulated, was able to accumulate the charge for the benefit of the lineman working innocently at some distance away. The wire would thus act like a Leyden jar of very uncomfortable dimensions.

It is a common thing in the electric business to get shocks from a steam dynamo, but shock from the steam of a colliery engine is a novelty that can, no doubt, be best appreciated by being felt. From subsequent experiments made by Prof. Maclean, it would seem that the electrification communicated by the steam was positive, which would be according to the rule in connection with hydro-electric machines. These machines were investigated by Faraday, Armstrong and others. They were evidently regarded as a great wonder and novelty at that time. The steam-boiler was mounted on insulators, and the steam generated was allowed to escape through a special form of vent. The issuing steam-jet became strongly electrified positively, by friction against the walls of the vent, and the steam boiler strongly electrified negatively. The apparatus formed a sort of electric steam-calliope. The principle does not seem to have been put to any useful application, and we have more important tasks for our steam-boilers. But if anyone complains of receiving shocks from a well-insulated and dead-ended wire, a search for the cause of disturbance should be extended not merely to solid bodies, but also to gases coming into contact with the wire.

Prof. Maclean is stated to have drawn a continuous stream of sparks ½″ to ¾″ in length from a wire terminating near the escaping steam of the exhaust pipe referred to, and indicating a potential of about forty thousand volts. The potential of the air, six feet above the ground, is stated to have been 1,100 volts when about 12 feet from the issuing steam, and 900 volts when 30 feet away. Consequently, the dead-ended wire on the poles may readily have received an electrostatic charge under a potential of several thousand volts, at 26 feet above the ground.

THE TRAIN LIGHTING PROBLEM.

The communication from Prof. Shepardson, published elsewhere in our columns, is one of the most complete resumés of the subject which we have had the pleasure of seeing. It is a very striking evidence of the practical difficulties of electric train lighting, that while the art is relatively old—as old indeed as the incandescent lamp—it has made so little progress toward general adoption. Railroads are, of course, conservative, particularly so when new expenses are involved, but the difficulties are genuinely serious. Yet electric light is so desirable that every one prefers it and it must make its way in train lighting as it has everywhere else. As to methods, their name is legion, by many inventors and in many countries, but they may be roughly divided into those in which the unit is the train and those in which the unit is the car. By far the easiest task is the lighting of a train as a whole, particularly a definite train made up in a regular manner. In such case it is a relatively simple matter to set up a little direct-connected unit in the baggage car and to light the train with a little aid from storage battery auxiliaries. The troubles inherent in this simple method are those that come from the use of small steam engines. Here it seems to us there is an excellent chance for improvement. The advent of the automobile, even if it accomplished nothing else, would be of very material use to humanity in stimulating progress in small prime movers. With modern automobile engines or with steam turbines the efficiency of a small direct-connected generating set may be raised very considerably above the maximum which would have been possible even four or five years ago, and trouble from unsteady speed and from vibration is reduced to a minimum.

Train lighting by this method demands comparatively small batteries but requires some extra labor which can be avoided by some other methods. It is, however, remarkably effective and has very little chance of going wrong. Of the schemes which make the car a unit, there are practically two varieties, one depending wholly on storage batteries the other on storage batteries plus axle-driven dynamos. The former is limited to runs of moderate length by the weight of batteries required, but within this limitation is the simplest plan possible. Its economic position depends entirely on the question of depreciation of the batteries—always a mooted point in electrical engineering. Batteries in such use are subject to serious mechanical risks, but otherwise work efficiently enough. With a judicious planning of the lights installed, the weight of battery can be kept within very reasonable limits and the electrical efficiency of the method is high. Still, the depreciation is or may be considerable, and we are not aware that as a whole the system is cheaper than that employing a dynamo on the train. In any method of train lighting batteries must be used if the cars are to be uncoupled at night, and we are disposed to think that granted the necessity of some battery, a full battery equipment has a good many points in its favor. We should much like to see a complete comparison between the cost of such operation, and that incurred on the system previously mentioned, the two being tried side by side under similar conditions. Such comparisons have several times been made, but they have usually been somewhat vitiated by the fact that the engineer had a bias one way or the other which affected the soundness of the comparison. Certainly both methods can and do give excellent practical results on a considerable scale.

Of lighting from the car axle as a motive power there have been many varieties, of which some have already come into successful use. The mechanical difficulties are, however, very great, both in the drive itself and in the devices intended to give constant voltage at varying speed of the dynamo, or constant dynamo speed at varying axle speed. Batteries are, of course, required to ensure continuity of service. In spite of the fact that axle-driven plants have been able to give good service, and the ingenuity displayed in overcoming the great difficulties involved is admirable, there is a suggestion of extreme technical versatility rather than a practical conservatism. It is a sort of *bravura* passage in electrical engineering which evokes our applause for its command of technique. But even a variety of successful methods does not imply electric train lighting upon a large scale. The car stove and the oil lamp still hold sway over a large part of the country and count up their victims month by month. Railroads fought against steam heating as long as they dared, and some of them are fighting still. So long as kerosene is cheaper than electric light, some railway managers will use it at whatever risk, but the public is gradually being educated to demand electric lights and they will steadily make their way. As between gas and electric light, there is very little to be said for the former, particularly in sleeping cars, except that it will cost good money to put aside the former for the latter. But after all, electric lighting has steadily forced its way against gas even when gas has been materially the cheaper, and in the long run train lighting will be no exception to the rule. When the long-distance electric road has once got a firm hold, the whole question will become a dead issue.

Coming A. I. E. E. Meetings in Chicago.

The Executive Committee of the Chicago branch of the American Institute of Electrical Engineers has held several meetings lately and has arranged a very attractive programme for the rest of the season. It contains several special local features which seemed desirable modifications of the regular Institute programme. The informal smoker and meeting for discussion of train lighting papers, held March 10, was announced last week. March 24 Mr. Bion J. Arnold will present a resumé of his recent exhaustive report to the Chicago City Council, on the Chicago transportation problem. This is a special local meeting and has been provided for by the local committee because of the general interest taken by the engineers and public in Chicago in Mr. Arnold's report, and the desire of many to hear Mr. Arnold personally present a review of the report. A number of lantern slides have been prepared by Mr. Arnold, to assist him in presenting this subject. A discussion will follow Mr. Arnold's remarks. In order to accommodate the large number of people that will probably wish to attend this lecture, it will be held at Fullerton Hall, in the Art Institute Building, Michigan Avenue and Adams Street, 8 P. M.

April 7, "High-Tension Lines" will be discussed at the regular meeting place in the Western Society of Engineers' rooms in the Monadnock Block, 8 P. M., as usual. May 5, "Tendencies of Central Station Development" will be taken up. Papers in these last two cases are the same as those mentioned for the general meetings of the Institute.

May 19 will be a telephone meeting. The Chicago branch held no meeting in February, and instead postponed its telephone meeting until the last of the season. Owing to the fact that the Chicago branch numbers among its members some of the best talent in the country in the independent telephone and engineering field, as well as some of the best Bell talent, it is thought that the scope of the telephone meeting could with profit be enlarged from that of the New York meeting held in February, which was mainly a discussion of Bell practice. At the Chicago meeting telephone engineering as developed by the independent companies, will be taken up more fully than at the New York meeting. Mr. Kempster B. Miller, of the local Executive Committee, will arrange for discussion by the leading independent telephone engineers, and Mr. Angus S. Hibbard, of the same committee, will see that the Bell interests are properly represented at the meeting. It is not the idea of the committee to make this meeting a fight between independent and Bell men, but to bring out in a manner becoming to scientific engineers the various methods of treating telephone engineering problems by all the various companies, both Bell and independent. Chicago has material for an excellent telephone meeting of this kind, because of the location of the majority of the great independent telephone factories there, as well as large Bell manufacturing and operating interests.

The American Street Railway Association.

As already noted, the twenty-second annual meeting of the American Street Railway Association will be held at the Grand Union Hotel, Saratoga Springs, New York, Wednesday, Thursday and Friday, September 2, 3 and 4, 1903. Papers will be presented on the following subjects: "Electric-Welded Joints," "The Evils of Maintenance and Champerty in Personal Injury Cases," "Train Orders and Train Signals on Interurban Roads," "Freight and Express on Electric Railways," "The Manufacture and Distribution of Alternating Currents for City Systems," "Comparative Merits of Single and Double-Truck Cars for City Service," "The Right of Way."

A fine exhibition of street railway supplies will be made at the hotel. The annual banquet will be held Friday evening, September 4, when the officers-elect will be installed. The headquarters of the association will be at the Grand Union Hotel, which is said to be the largest hotel in the United States. No rooms will be assigned prior to April 15, but those intending to be present should make application to the hotel early, as they will be assigned in the order in which received. Other first-class hotels are the United States, American-Adelphi, Congress Hall, Worden and Kensington. Railroad rates will probably be as in former years.

The following resolution was unanimously adopted by the committee: "The secretary is directed to request the chief executive officer of the different companies to notify all delegates and heads of departments attending the convention that they are expected to be present at all sessions of the meeting and take part in the discussions."

Saratoga friends are very anxious to have a large delegation of both members and their ladies and promise all a very enjoyable time. Another circular will be issued later, giving particulars regarding the meeting, by Mr. T. C. Penington, secretary.

Lighting the St. Louis Exposition.

The keynote of the lighting of the Exposition is given by the plans of Chief Rustin for lighting the Varied Industries Building. The effort will be to make the night picture of the Exposition entirely different from the day picture, so that two distinct artistic compositions will be presented to visitors. By day the columns which form the colonnades around the central avenue will be the most noteworthy feature of the main picture. They will stand out white and majestic. At night these columns will be silhouetted darkly against walls of light. This effect will be produced by inserting in the rear fluting of the column a close line of 8-cp incandescent lamps, and by peppering the recessed ceiling of the cloister closely with lamps of similar power. These lamps will not be seen from the outside. The front of the columns will not be lighted except by the diffused lamps in the avenue. To a spectator at a moderate distance the columns will be dark projections on the white of the screened wall. During the day this wall and the recessed ceilings of the cloisters will attract little attention because they will be in deep shadow. Here it is proposed to install mural paintings and to use color which cannot be used without detriment to the picture on the exterior walls.

This is the plan for the Varied Industries Building. The architect has supplied plastic decoration which will lend itself well to the illuminator's work. The frieze of the cornice which runs completely around the building has at regular intervals a gigantic white wreath enclosing the letters in a monogram "N. J."—the initials of Napoleon and Jefferson. This forms an attractive day picture. A 3-cluster lamp will be placed in the center of each wreath. The cornice lines will be marked with lamps at regular intervals, so disposed as to light the cornice throughout its height.

The plan for lighting the domes has not yet been decided and cannot be until the staff decorations are more fully developed. The interior lighting of the big exhibit buildings of the Exposition will be by arc lights.

Hydraulic Developments and Electric Installations.

Mr. William B. Jackson, of Madison, Wis., presented a paper on the above subject before the Western Society of Engineers at Chicago, March 4, 1903, which was read by his brother, Prof. D. C. Jackson. One of the principal purposes of the paper was to call the attention of hydraulic engineers to the differences in the requirements of a hydraulic plant for electric work, as compared to mill work. One of the chief differences is due to the fact that in a hydraulic plant operating electric generators for commercial purposes, it is not feasible to shut down part of the plant when there is low water and resume operations when the water is high, unless steam plant reserve is provided. An electric generating plant calls for a continuous output, although the output may vary from one hour to another. The 365-day power he considered the cream, and all the other power only a valuable by-product.

The cutting down of the head of the water power, on account of high water conditions was given considerable attention, and various plans illustrated for overcoming the variation in power of the water wheels due to this cause. He considered that usually poor workmanship had more to do with the failure of a dam than poor design. It was not considered possible to calculate the minimum flow of a stream from the area of the water shed and rainfall. This latter conclusion was also borne out by those who participated in the discussion of the paper.

The 22,000-Volt Transmission Installation of the Northern California Power Company.

THERE has just been completed in Northern California another high-tension power-transmission installation for supplying electric service to the Counties of Glenn, Shasta and Tehama. The Northern California Power Company own and control the Keswick Electric Power Company, the Redding Electric Light & Power Company, the Redding Water Company and the Tehama Electric Company. The officers are H. H. Noble, president, and W. W. Marvin secretary, the main offices being in San Francisco, Cal.

The main power house, which is located at Volta, Shasta County, Cal., is connected by transmission lines carrying three-phase alternating currents of 22,000 volts, with sixteen sub-stations located in the counties above referred to. The current is utilized for not only arc and incandescent lighting in the various towns, but also for supplying power to numerous large users. Among these may be mentioned the Great Mountain Copper Company, receiving current from the Iron Mountain and Keswick sub-stations, and the Bully Hill Mines, using current from the De La Mar sub-station.

About 30 miles from the power house at Volta, near Shingleton, there is a sub-station at Redding, and others are located at Horsetown, Palo Cedro, Cottonwood, Vina, Orland, Germantown, Willows, Red Bluff, Anderson, Tehama, Winthrop and Corning. The current is used with motors of various sizes all along the transmission line at the different villages and towns.

The water supply for the power station is very constant, being obtained from springs delivered through Mill Seat Creek, which alone will supply 3,000 hp at low water periods. Water rights have also been secured from Berry, Battle and Galpin Creeks and connections have been made by lateral ditches with Mill Creek.

The water is carried through a ditch 3,500 ft. long from Mill Creek several miles from its source to a reservoir, known as Lake Nora, on an elevation above the power house; this reservoir is capable of taking care of the full load of the station for half a day if repairs should be necessary. At the intake there is a rock-filled timber crib and a head gate which allows the water to pass to the pipe line. The water is here screened by a fine and a coarse set of wire and bar screens. The head gate is operated by a hand wheel, roller or ball bearings being employed for ease in working.

For nearly 300 yards the water is conveyed in a wooden pipe about 3½ ft. in diameter, and for the remaining distance of a trifle over a mile a 30-in. steel pipe is employed varying in thickness up to ⅝ in. near the power house, where the head is over 1,000 ft. There are half a dozen automatic air valves in the steel pipe line about 1,000 ft. apart. The line ends in a lap-welded receiver 12 ft. in diameter.

In the power house, which is built of stone and iron, there are three turbines of 1,500 hp located in one room, each driving a Westinghouse three-phase alternator by flexible insulating couplings. In an adjoining room there are ten step-up transformers for raising the pressure of the generators from 500 volts to 22,000 volts for transmission to the various sub-stations.

A pair of cranes of 20,000 pounds capacity each are located in each of the two rooms of the power house for handling the heavy parts of transformers, generators and turbines. The water pipes connecting the turbines with the mains as well as the nozzles are placed in cement, the covers of the latter being flush with the floors. There are two other turbines which drive the exciters, which operate under a head of 400 ft., the water being carried by a separate ditch to the forebay located near the main line of pipe. This water is taken from streams below the first diversion of the water from Mill Creek. These small 18-in. Pelton turbines are supplied from the forebay by a pipe 6 in. in diameter, and drive the 22-kw Westinghouse exciter dynamos at a speed of about 1,000 r.p.m. A deflecting nozzle is used for regulating the load of the exciter, by operating which by a hand wheel the excitation of the alternators may be effected.

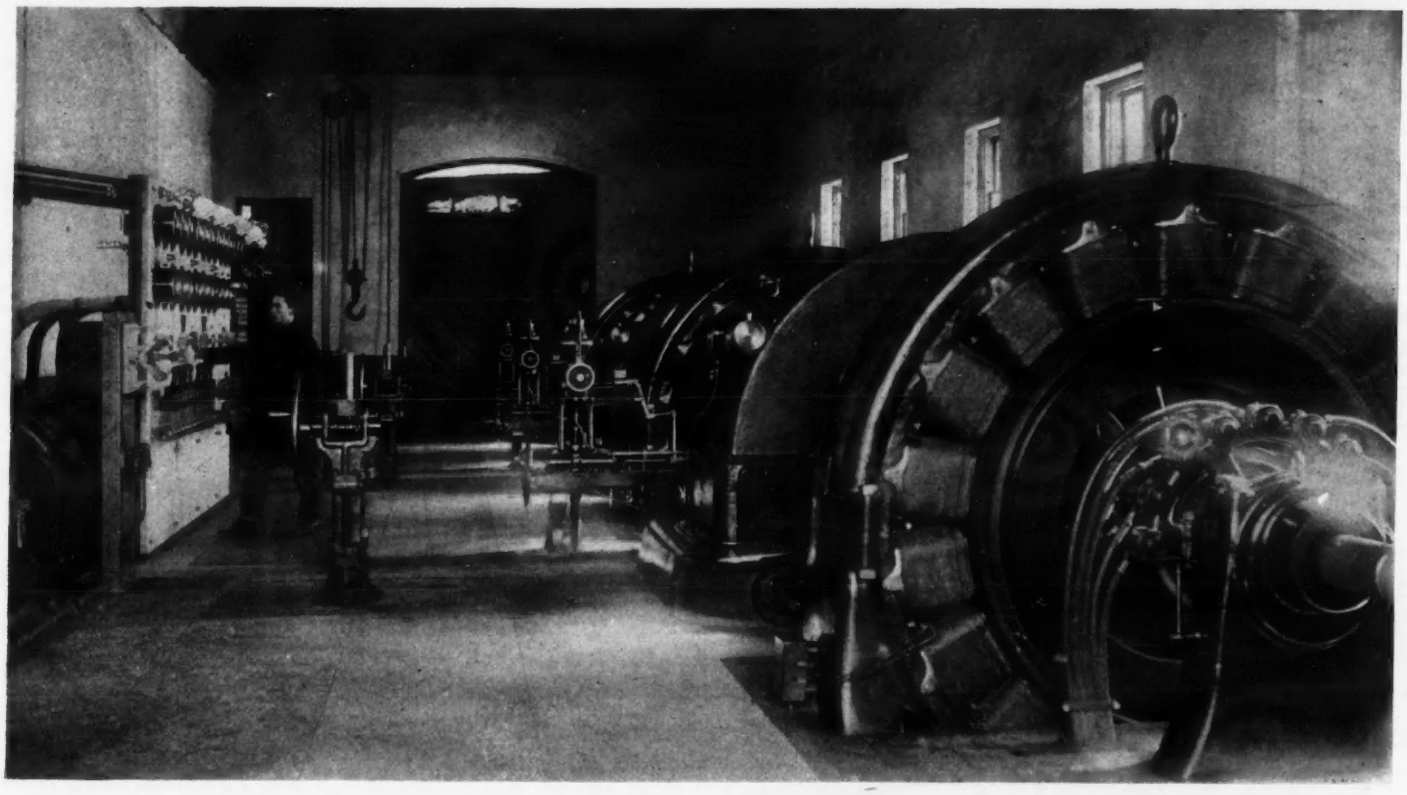


FIG. 1.—VIEW OF INTERIOR OF POWER HOUSE AT VOLTA.

The large turbines are supplied with water from the receiver through three lap-welded steel pipes. The water is controlled by two high-pressure valves, one near the wheels with steel roller bearings and worm gearing capable of standing a pressure of more than fifty tons on the disc; and the other near the receiver, which is in reserve for an accident. There are heavy ball-and-socket deflecting nozzles for handling the various loads, different tips being used when necessary. Three Lombard governors are employed for operating the nozzles on the three 1,500-hp Pelton water wheels, holding their speed practically constant, regardless of the load on the generators. Each of the three deflecting nozzles are a foot in diameter, and there is a 30-ton pressure on each of the ball joints. A factor of safety of about 20 is employed in the construction of most of the hydraulic materials used in these connections.

The buckets and wheel centers of the Pelton wheels are of cast steel, having an elastic limit of about 20 tons per square inch and a tensile strength of about 35 tons. The buckets are driven on the wheel center discs and bolted in place with special turned steel bolts; for when the water wheels operate at 800 r.p.m. they have to

stand an impact from a 4-in. stream under the enormous head of 1,204 ft.

The water wheels as well as the alternators have automatic oil bearings, bronze rings carrying a flood of oil continuously over the top of the shaft. The three 750-kw alternators supply three-phase currents of 500 volts, which are conducted to the three generator panels of the main switchboard. This main switchboard consists of four panels with the necessary measuring instruments, switches

FIG. 2.—SUB-STATION AT KESWICK.

and pilot lights, the last panel being connected with the exciter dynamos.

From the main switchboard the cables carry the current to the three sets of transformers, which raise the voltage from 500 to 22,000 for transmission over the long distance line. There are in all ten transformers, each having a capacity of 250 kw, one being held in reserve for use in case of an emergency.

One high-tension transmission line consisting of three No. 4 B. & S. copper wires connects the power house with the sub-station at Keswick, a distance of 37 miles, where a number of smelters are in operation. Another line of the same size and number of conductors proceeds to Redding about 30 miles from the power house

FIG. 3.—POWER HOUSE AT VOLTA.

and several miles further to the sub-station at Iron Mountain, which latter supplies current to the mine of the Mountain Copper Company. Still another transmission line conducts current 20 miles from the power plant to Palo Cedro. Branch circuits connect the other sub-stations with the generation station.

The bare conductors of high conductivity copper are mounted on glass insulators tested to 50,000 volts potential, and mounted on eucalyptus pins one foot in length, fixed to Oregon pin cross arms. The poles are of cedar and redwood, the former 30 ft. long and the latter 40 ft. long, the cedar being used in the country.

The sub-station at Iron Mountain is constructed of iron and stone and is equipped with 6 step-down transformers, each having a capacity of 75 kw. The current is reduced from 22,000 volts to 2,000 volts and is used to operate induction motors in the mine of the Mountain Copper Company.

Near the smelting works of this same mining company, located at Keswick, there is another sub-station of much larger capacity. The transformers at the Keswick sub-station are of the Westinghouse oil-insulated type and each of the 6 installed at this plant has a capacity of 150 kw. These transformers also reduced the 22,000-volt transmission line pressure to 2,000 volts. The current is utilized not only in the mine for operating induction motors, but also for supplying energy for the arc and incandescent lights of the town. The switchboard equipment of this sub-station includes six marble panels, four of which are used as feeder panels and the remaining two connected with the sets of transformers.

The Northern California Power Company has acquired the Redding Water Company, and near the waterworks is located the Redding sub-station, which is constructed of iron and rubble stone. There are two transmission circuits passing through Redding and special 22,000-volt, high-tension, two-way switches are provided, so that this sub-station may be supplied from either high-tension line.

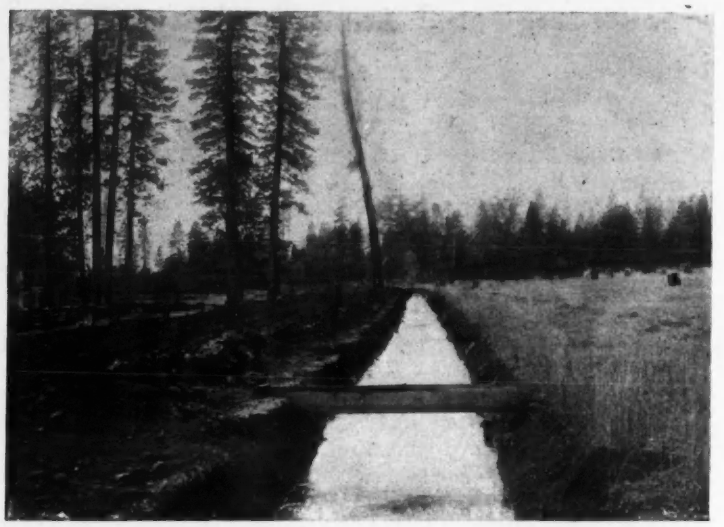


FIG. 4.—MAIN DITCH LEADING TO RESERVOIR.

The transformer installation consists of 75-kw transformers, five in number, arranged with Scott connections, so that the three-phase, 22,000-volt currents may be transformed and lowered to a 2,000-volt, two-phase current. Provision is made for operating large motors for driving an immense pump for supplying the town with water should the two-million-gallon pump now operating by water power become disabled in any way.

Another new power plant of 4,000 hp is now under construction taking water from Cow Creek about 20 miles away, and in this plant two 1,500-kw Westinghouse revolving field generators will be employed, each driven by a 3,000-hp Pelton wheel. The head will be about 1,200 ft., similar to that at Volta, and about a mile of pipe line will be employed in feeding the turbines with water. This plant is expected to be in operation some time during the coming summer.

National Electric Light Association.

The twenty-sixth convention of the National Electric Light Association will be held at Chicago, Ill., May 26, 27 and 28, 1903. The headquarters of the association will be at the Auditorium Hotel, and hotel rates will be as follows: Room with bath for two people, $5 to $6 per day; single room with bath, $3.50 per day; rooms without bath (for each person) $1.50 per day and upward. All on the European plan. A combination breakfast will be served in the Auditorium proper at a fixed price. Table d'hote luncheon will be served at sixty cents and table d'hote dinner at $1.25. Rooms should be reserved as early as possible, as there is likely to be a very large attendance, and application should be made direct to the hotel management. Mr. James B. Cahoon, secretary, 136 Liberty Street, New York, should be addressed for further information.

Some of the Problems of Electric Train Lighting.*

BY GEO. D. SHEPARDSON.

THE use of electric light in transportation is no new thing. The first commercial plant sold by the Edison Company to be operated by outside parties was installed on the steamship *Columbia*, in 1879, at Chester, Pa., and began operation in May, 1880. Another of the very early isolated plants was used for lighting the shops of the Manhattan Railroad, beginning in the fall of 1881. At about the same time a plant was installed in the Baldwin Locomotive Works. The first Edison central station started at Appleton, Wis., about August 20, 1882, and the larger Pearl Street Station, in New York City started on September 4, 1882, were antedated nearly a year by the application of electric lights to a Pullman sleeper running between London and Brighton, England, in October, 1881. The latter had 12 small lamps supplied from 32 Faure cells. This was so successful that by December of the same year the whole train of 8 cars were equipped with 29 Edison lamps of 9 to 10 cp, supplied from 80 cells of storage battery. An electric headlight operated by steam engine and dynamo mounted on the locomotive was used on the Kronprinz-Rudolf-Bahn on the night of March 19-20, 1881, and was followed in December of the same year by others in France. As early as 1879 Hinkefus and Wesel took out a German patent on a train-lighting system in which a dynamo driven from the car axle operated incandescent lamps. Even before the Pearl Street Station was in operation, the Pennsylvania Railroad began experimenting with incandescent lamps operated by storage batteries under the cars, importing Faure cells from France in the spring of 1882, and installing them on a car in August of the same year; although this experiment was not a conspicuous success, the company renewed its experiments in 1884, and in the following year began the regular operation of electric lighted cars. From the beginning, the company has continually increased its electrical equipment, until recently it has adopted the electric light as standard for all passenger service.

From the standpoint of the railroad man, the requirements for a system for train lighting are reliability, safety, freedom from features objectionable to passengers, cheapness in first cost and low cost of maintenance. All of these requirements are matters of degree. For absolute safety from fire and explosion, nothing can equal the incandescent electric lamp when installed and maintained in accordance with established practice. The voltages used on trains are invariably low and well within the limits of danger or even discomfort to persons who might by some unusual way come into contact with the conductors. That the service may be made reliable is attested by the fact that many cars provided with no auxiliary light whatever are in use on such roads as the Chicago, Milwaukee & St. Paul, which has been using electric lights since 1890. The Pennsylvania road, which was the first in America to experiment with electric lights for car lighting, is now equipping all of its cars west of Pittsburg with electric lights, and is reported to be throwing out all auxiliary lights. The incandescent electric light is free from the smoke, smell, vitiation of atmosphere and the possibility of fire and explosion common to all competitors, and it yields such a moderate amount of heat that it may be said to be absolutely free from features objectionable to passengers, except those of occasional dimness or of infrequent unsteadiness. Furthermore, the advantage of adaptability to local and decorative lighting, such as dining table or berth lighting, and the possibility of advertising tail transparencies, the convenience of electric fan ventilation and of electric heaters, make the electrically-equipped train the choice of fastidious travelers. In the matter of cost, electric lights compare favorably with others when quality and quantity are considered.

The application of electricity to train lighting is now over twenty-one years old and may be said to have reached its maturity. It has not ceased to develop and improve, but it has reached the age of responsibility and reliability. Like other adults, it still meets problems to be solved and looks forward to a bright future.

The application of electricity to train lighting is, therefore, in its twenty-first year, and may be said to have reached its maturity. It has not ceased to develop and improve, but it has reached the stage of responsibility and reliability. Indeed, for several years past, numbers of cars have been provided with no auxiliary light whatever, showing that the previous experience of the roads using electric light has been satisfactory. The advantages of electricity for car lighting are so thoroughly appreciated by the traveling public and by the railway officials, that no train can now be said to be thoroughly up-to-date unless it lists electric lights among its attractions. The absence of products of combustion, excessive heat, humidity and carbonic acid, the convenience of berth lights, which are impracticable with any competing source of light, the comfort of electric fans. the safety and convenience of electric heaters, their decorative effects obtainable only by incandescent electric lights, these entirely overbalance any increased cost of electric over other systems.

All of the various systems of car lighting which have been put into practical application have adopted constant-potential direct current as the only satisfactory source of supply. The voltage varies from 30 to 110. The number and strength of lights varies through wide limits, some advocating 10 to 88-candle lamps per car, or 80 to 640 cp per car, some cars having as high as 26 50-cp lamps, or 1,300 cp per car. Tests made by the writer in 1900 showed an illumination in different cars varying from 0.008 to 7.5 candle-feet. The stronger illumination is not only more pleasing to patrons and a conspicuous advertising agency, but further the flood of light effectually masks ordinary variations due to imperfect regulation.

The various plans for the supply of power for electric lights on cars may be classified as battery, dynamo and combination. The dynamo may be driven by an independent engine in the baggage car or on the locomotive, or it may be driven from the car axle. It may supply the lights directly, it may charge storage batteries or may combine the two. The battery may be large enough to supply all the lights through a single run or through a round trip, it may carry all the lights for only a few hours, or it may carry only part of the lights a short time for occasional use. Each of the various systems meets its own problems of mechanical, electrical and financial natures.

Battery Troubles.—When a battery is used without any dynamo on the train, it should have sufficient capacity to carry the load through the entire run without falling below normal voltage, a difficult task on long winter nights without excessive weight. Fortunately, the greatest amount of light is usually required when the car first leaves the charging station, and when its voltage is highest; as the battery gives up its charge, the load generally lessens and allows the voltage to remain fairly constant through the night. When properly proportioned to the load, the performance is excellent. For example, some of the Pennsylvania cars running between Chicago and Jersey City and charged only at Chicago, make the round trip with 32 to 24 volts at start and with 30 volts upon return. As the cells become old, however, their capacity decreases, and the battery lighted cars sometimes give unsatisfactory service toward the end of the run. For transcontinental service the unaided storage battery seems impracticable. The short time allowable for charging at terminal stations often involves excessive high rates of charging and rapid lowering of the electrolyte. The difficulty of close and thorough inspection of cells often results in no inspection until failure is reported. The difficulty of allowing good ventilation of the battery boxes while keeping out the dust and other dirt, involves difficulty from low insulation and from decay of the battery trays and boxes. Injury to car body and to battery boxes is minimized by liberal use of insulating paint, but seems difficult to avoid entirely. The shaking of the cells incident to railway usage causes somewhat more rapid deterioration than in corresponding stationary service. Slopping of the electrolyte is avoided by using deep jars with or without covers; the space is so fully occupied by the elements that there is comparatively little liability to slopping except in case of unusually violent handling of the cars. The weight of battery including boxes, etc., on a car with "full battery" equipment is about 3,000 pounds, which is not a very large proportion of the total 91,000 pounds weight of a coach or the 116,000 pounds weight of a sleeper. The first cost of about $600 per car for "full battery" equipment, in addition to $300 to $400 for wiring, is not great in comparison with $8,000 to $10,000, the cost of a coach, or in comparison with $16,000 to $20,000 expended for a sleeper.

When the battery is charged during the run there is more or less loss and deterioration due to the overcharging necessary to reduce the liability to failure on account of incomplete charging. The excessive charging and occasional over-discharging causes a more or less rapid deposition of mud at the bottom of the jars, which is liable to reach to the plates and so cause short-circuiting. The

* A communication read at the February meeting of the American Institute of Electrical Engineers.

corrosion of connections due to the spray is frequently the cause of local action.

Engine Troubles.—On systems supplied from dynamo driven by steam engines, trouble is sometimes experienced from breaking of the flexible connection between the baggage car and the locomotive. It is common to use either the Moran ball-and-socket flexible joint or rubber hose strengthened by steel wire or expanded metal. The life of rubber hose varies from a few hours to several months. A blown-out hose can be renewed in a few minutes at the first stop of the train. There is sometimes trouble in disposing of the exhaust from the engine, which generally passes through the roof; when a good muffler is used, the grease is retained for the most part and is led through the bleeder through the car to the track, so that it is not carried back and deposited on windows and sides of cars; sometimes in winter the condensed steam collects on the bellows of the car vestibules to such an extent as actually to break the end of the car by the motion of the train. The reciprocating parts of the engines commonly used cause some vibration of the baggage car, which is transmitted through the couplings and may be felt to the extreme end of the train when in stations; the skill of the engineer in stopping the train is a large factor in the extent to which the vibration is felt through the train, it being least when there is a medium amount of slack. The adoption of the steam turbine may remove this difficulty. When the train is lighted from a dynamo and engine, some auxiliary source of light is necessary for the short intervals caused by changing locomotives, such relay being a storage battery or gas or oil lamps. The small engines use an excessive amount of steam per horse-power-hour. The labor cost is not great; for example, on the Chicago, Milwaukee & St. Paul road each train on a run of 400 miles, between Minneapolis and Chicago, is allotted four baggagemen, who receive $10 per month additional wages on account of attending to the electrical equipment, making a cost of $1.33 for wages for 400 miles. On the Northern Pacific road the baggageman has more than one man can handle, and an electrician goes with the train to attend to the engine and dynamo and to help the baggageman when necessary.

Axle System Troubles.—One of the greatest difficulties has been to secure satisfactory mechanical connection between the car axle and the dynamo. Gearing, belting and friction drives have been attempted with some degree of success. The latitude of motion of the car axle in three dimensions imposes upon the dynamo drive very difficult conditions. This, with the difficulty encountered from the dirt and stones thrown up by the motion of the train and from the steam and snow or rain, which may freeze upon the belt, imposes a problem whose satisfactory solution has required great ingenuity and expensive experimenting. That the axle systems are being adopted extensively is a triumph indeed. Direct gearing similar to that used in electric railway practice has attracted many minds; the danger from a hot box or defective gear on a railway train drawn by a locomotive of several hundred horse-power is a very different thing from a similar defect on a car moved by the geared motor itself, which is protected by fuses and circuit-breakers. The next great trouble is the wide range of speeds met in train operation and the necessity for maintaining constant voltage from the time when the train is standing, through the point where the dynamo cuts in and takes the load, to the highest speed attainable. The problem of regulation under such circumstances is one of no mean magnitude, and many are the ingenious plans proposed for its solution. Not only must the regulation take care of the varying speed of the train, but the battery voltage changes according to the state of charge, so that resistance or its equivalent must be inserted between the lamps and the dynamo or battery, according to circumstances, in order to keep the lamps at normal voltage. When one watches the operation of an axle-lighting system which is so carefully designed and adjusted that no perceptible change occurs in the brightness of the lights between standstill and full speed, between the time when the battery is discharging and when it is charging, one cannot but admire the success of the engineers in charge.

Financial Considerations.—All sorts of figures are given in connection with the cost of electric train-lighting systems, some showing that each electric system is more expensive than any other, others showing that some particular electric system is the cheapest. The real cost varies greatly, according to the intelligence with which the whole plant is operated, this intelligence including both that of the engineer in immediate charge and that of officers of the road who limit his facilities for proper handling of the equipment. In any case, the entire cost of maintaining the electric lighting system is a very small proportion of the entire cost of running the train, including not only the "operating expenses," but also that part of the general expenses chargeable to the particular train. The latter part of the cost, which is no inconsiderable part, is not usually obtainable. From the cost of operating the electric lights should be deducted the net profit from the added traffic which is attracted from other roads, or which is created by the improved luxury of travel on electric-lighted cars. These data are difficult, if not impossible to secure with accuracy. If the added revenue created by the electric features of a train bears to the entire revenue from the train as great as or greater proportion than added cost of electric light, above other forms of light bears to the *entire* cost of running the train, then the electric light pays for itself.

Electricity as a Motive Power in Mechanical Flight.

BY DR. T. BYARD COLLINS.

THE management of the Louisiana Purchase Exposition, soon to be held in St. Louis, is offering prizes aggregating $200,000 for the purpose of stimulating study and inducing activity in the field of dynamic flight, and for securing, as an attraction at the exposition, a demonstration of the practicability of aerial navigation. The amazing revelations of recent years made by Nature at the behest of her inquisitors, have prepared the world for a belief in the possibility of aerial navigation and rendered her expectant of the advent of some adequate means for the accomplishment of mechanical flight. Indeed, the possibility of solving the problem is almost universally admitted; it is a manageable machine that is now called for—one that may be directed and controlled in all ordinary weather, rather than one, like those hitherto constructed, which might only venture out on the most ideal of days.

Mr. Santos Dumont is just completing in Paris a large model of a dirigible balloon, in which he expects to carry passengers. During the summers of 1901 and 1902 he built and sailed several structures in succession, the most unique being his No. 4, familiar in public prints. His No. 6, with which he rounded the Eiffel Tower and won the Deutsch prize, was an elongated ellipsoid, 105 ft. by 20 in diameter at its greatest cross section. It was provided with a 13-ft. screw, which made 100 r. p. m. The motor was an 18-hp gasoline, of the Buchet type. With this structure, the Brazilian succeeded in rounding the tower and making a record of 18 miles an hour. But the mildest of breezes was blowing, and, being diagonally across his course, was utilized for tacking and was thus a great help in obtaining this favorable record. The best average the now famous balloonist ever made in a dead calm was approximately 14 miles an hour.

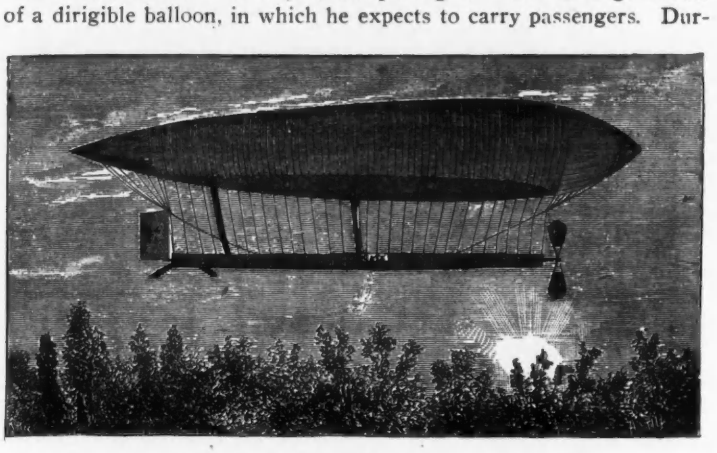


FIG. I.—RENARD & KREBS'S ELECTRIC BALLOON.

In 1884 M. Tissandier demonstrated afresh the practicability of propelling and steering a balloon, following Giffard, who put the first model of this make on exhibition in 1852. Tissandier's aerostat was in shape not unlike the Santos Dumont No. 6. It was 90 ft. long by 30 in diameter. It was propelled by a 10-ft. screw, driven by a Siemens motor, which was actuated by four large bichromate batteries of six cells each, each cell holding about six gallons of solution. The motor made 1,800 r. p. m., the screw 180. This was the first application of electricity to the propulsion of aerial craft.

The next year Captains Renard and Krebs, under commission

from the French War Office, brought out their dirigible balloon, a conception of the general outlines of which may be had by a reference to Fig. 1. This structure was 163 ft. long by 27½ in greatest diameter. It was provided with a 23-ft. screw, which made 46 turns per minute. In this case also the power was electrical, thirteen elements being employed and developing the equivalent of 8½ hp on the shaft.

The first route chosen was from north to south over the plateau from Chatillon to Vervières. Between Choisy and Versailles the direction was changed and the fore end was pointed toward Versailles so that the balloon should not get entangled with the trees. Over Villacoublay the aeronants decided to retrace the track. The balloon made its half turn to the right by giving a very slight angle to the rudder—11 degs.—and presently was back again to its starting place, having made the distance of 4½ miles in 23 minutes. Several subsequent trips were made, all equally successful, the speed sometimes attaining 14½ miles an hour. The results obtained were, therefore, about the same as those achieved by the recently renowned aeronaut of the Paris Aero Club.

The engineering objections to this form of flight are not only well known, but are almost obvious to everyone. It requires approximately 14 cu. ft. of hydrogen gas to lift a pound. By the time an envelope has been made large enough to hold sufficient gas to lift any considerable weight the cross-section presented for the pressure of the atmosphere upon it while in progress, or for resistance to the air when the air itself is in motion, is so great as to render aerial navigation by this method impracticable.

A grave objection also to the prevailing method of propelling a balloon is the position in which it has been found necessary to place the propelling instrument—from 15 to 20 ft. below the center of resistance, it being found impossible hitherto to attach any portion

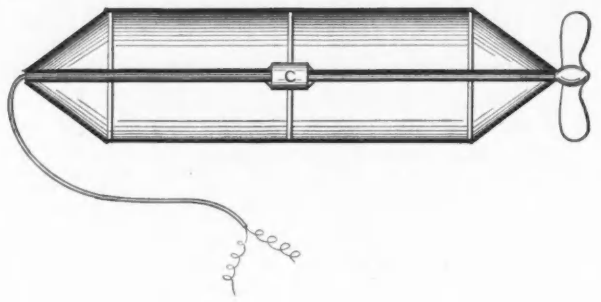


FIG. 2.—PROPOSED FORM OF AIRSHIP.

of the machinery directly to the fabric of the gas holder. And finally, it is pointed out that an aerostat of this character is necessarily so frail as to render it incapable of withstanding the buffetings to which a practicable machine would be subjected.

It is to be remembered, however, that this method of flight is not without its advocates in the engineering world—advocates of indisputable ability—that at this moment Captain Renard is reliably reported to be designing another "dirigible" for his government, and that the British military authorities also have recently commissioned Dr. Barton to construct for army uses a propellable balloon, in which work he is at present engaged. The question of motive power for aerial navigation becomes, therefore, a matter of interest.

Comparing the work of M. Santos Dumont with that of Tissandier, Renard and Krebs, it would appear that the Brazilian has made almost no advance upon the achievements of his predecessors, and this, notwithstanding the greatly improved facilities which might be supposed to have been, after a lapse of eighteen years, at his command.

One of the most serious difficulties encountered in the 1902 experiments was with the engine, which was continually failing to work, constantly threatening disaster, and always exhausting its fuel and thus altering the ascensional power of the aerostat; and which, by its vibrations, so disturbed at times the equilibrium of the entire system, as to threaten the prevention even of the limited success which was eventually attained.

With the electrical equipment of the "La France" of Renard and Krebs, none of these difficulties made themselves manifest; and when it is remembered that the earlier balloon was very much larger than the later one; that, with a lifting capacity more than three times as great, the speed attained was approximately the same, and that considerable improvement has been made in the construction of motors and batteries during recent years, it would seem that electricity is a source to which we may reasonably look for the motive power of the coming aerostat.

The theorem of low speed for the propellable balloon is capable of easy demonstration, and must be accepted as proven. With the resistance increasing directly as the expanse of surface exposed and as the square of the velocity, we come presently to a point where progress is impossible. It may be possible to obviate other disadvantages, but this form of air ship will always be a slow sailer.

As to the disadvantages of the propeller's present position, the electric motor offers the only method of removal. The late M. Severo sought to do this by swinging his great balloon in an immense frame and placing the propeller at its upper end, so that the line of traction would correspond with the center of resistance; power being transmitted to the screw by means of gear wheels and shafting from a gasoline engine, which stood but three feet below the bottom of the balloon. The consequence was that on the very first ascent, at an elevation of more than a thousand feet, the balloon exploded, precipitating the unfortunate aeronauts to a terrible death.

For rendering the envelope of the aerostat rigid and less frail, it is proposed to construct a frame consisting of a horizontal axis of steel tubing to which rims are attached at certain intervals by means of wire stays, just as the rim of a bicycle wheel is joined to its hub. The envelope is then drawn over the frame, which offers also opportunity for the attachment of certain parts of the mechanism. (See Fig. 2.)

Now, while hydrogen gas is combustible, it is only so in the presence of oxygen, and it is itself not a supporter of combustion. A familiar experiment in our college laboratories is the filling of a test tube with hydrogen gas, setting fire to the gas escaping from the mouth of the tube, and at the same time extinguishing the taper by thrusting its lighted end into the depths of the tube. It shows that in the handling of hydrogen there is a zone of danger from fire, but passing beyond this zone to the interior of the containing vessel, combustion cannot take place; so that the interior of the gas bag is the safest place for the motor.

There is thus offered a basis for an advantageous plan of construction. The propeller may be placed at the center of the resistance, as shown by the lines, *a* and *a*, in Fig. 3. A minimum amount of shafting running down the tubular axis would connect the screw with the motor, which would be placed at *c* in the interior of the balloon. Proper packing would preclude the admission of air. Conductors would lead to the motor through the posterior portion of the axial tubing, thence to the batteries in the car below, which could be in such proximity to the body of the balloon and so attached to it as to render the entire structure a unit instead of a system, the advantage of which is too obvious to need comment. But, however, obvious the advantage of the above arrangement, it is also obvious that only an electric motor may be placed in the position proposed, all others requiring oxygen in their operation, the more common forms involving the use of fire also. But with a rigid balloon having its propeller operating in a line with its center of resistance and an electric motor swung to the framework of its interior, the power available would be greatly conserved and the aerostat might be expected to make much better headway than has heretofore been attained.

Two plans are proposed for the accomplishment of mechanical flight, properly so called, i. e., aviation in which the gas bag plays no part, the structure performing its purpose by mechanical means alone. One of these is the flying machine, in which flight is achieved by the direct reaction obtained by means of its moving parts, as vertical screws, vibrating wings and the like; the other is the soaring machine or air runner, depending for its support upon plane surfaces, aero planes, at a small angle of inclination, driven rapidly through the air by means of screws or some other form of propulsion. Of these methods, the flying machine is less developed, not having received, as it seems to the author, the time and attention it deserves.

The most successful machine of the other make is Professor S. P. Langley's Aerodrome, the first authoritative account of which was given in this country at the Conversazione of the American Institute of Electrical Engineers in 1901, a complete report having been recently issued by the Smithsonian Institute. The Aerodrome had 54 square feet of sustaining surface disposed as rigid wings. They measured 14 ft. from tip to tip, and the weight of the entire struc-

ture was 30 pounds. It was driven by twin screws placed amidships, as shown in Fig. 3, the power being provided by a steam engine of 1½ hp capacity, the equipment complete—engine, boiler, firegrate and all, weighing less than 7 pounds. This, of course, is much lighter in proportion to power than we may hope to obtain with an electrical equipment, but the items of fuel, water, etc., must be added in the case of the engine, whereas, in computing the weight of electrical motive power, these items are entirely eliminated; this should go a long way, in a practical machine, towards equalizing the two systems, considered only from the viewpoint of weight.

The matter of vibrations will always be of importance in the motive mechanism of airships, since the stability, difficult enough to attain even under the most favorable conditions, will be greatly affected thereby; and on account also of the fact that the flying structure will necessarily be as frail in framework as is consistent with safety, it will be particularly important that all such vibrations be eliminated. Only the electric motor offers the smooth running conditions called for. Moreover, the exhaustion, en route, of the fuel, water, etc.—the continual alteration in load with the progress of the journey, as would be the case if an engine were used, would be a possible disadvantage in any form of airship, as it certainly is with the balloon as built at the present time.

The sole objection to electricity as a motive power for aerial navigation is the weight involved; in every other respect it is the ideal power for the purpose. Regarding this feature, two observations may be made. One of these is that extraordinary lightness is not a *sine qua non* of successful flight; and the other is that we probably

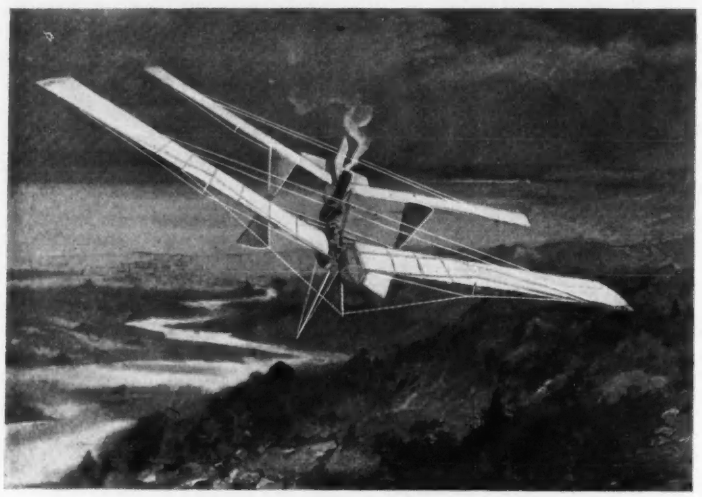


FIG. 3.—LANGLEY'S AERODROME.

have not yet reached the limit of lightness possible in the construction of batteries and motors.

The weight of the average pigeon is one pound, and the measurement of its muscle development shows it to possess 1-83 of a horse-power. The wild goose has a weight of 9 pounds, with a muscle development of only .026 of a horse-power, or 1 hp to every 346 pounds. This, of course, includes the flying creature complete; but suppose, in the case of the airship, that a large margin be allowed for the weight of the structure, we would still have from 150 to 200 pounds to put into every horse-power. This is at present within the limits of possibility. It is claimed that the new Edison battery weighs less than 61 pounds per horse-power, and it is not apparent at present how this can be improved upon, though even such an achievement is not inconceivable; but motors might very readily be reduced one-half in weight by using aluminum wherever practicable and cutting away all surplus metal in the make-up. The fact is that the demand for lightness in electrical power construction has not been such as to induce inventors to strive for the attainment of this object. When the time comes they will not be found wanting. In the meantime, the statement still stands that electricity is the ideal motor power in mechanical flight.

Wireless Congratulations to the Pope.

On the occasion of the recent jubilee celebration of the Pope at Rome, Cardinal Gibbons transmitted a congratulatory message to the Pope by wireless telegraph across the ocean. The message was sent from this side and received at Poldhu in England, and thence transmitted by wire to Rome.

The Heyland Induction Motor—I.*

By Boy De la Tour.

MUCH has been said, of late, concerning a new arrangement devised by Mr. A. Heyland, which makes it possible to design induction motors having a power factor equal to unity.

The articles published in various scientific periodicals by the inventor himself confine themselves to a summary description of the construction of the new machine, without attempting to discuss the theoretical considerations involved, and without seeking to explain the operation of the machine by means of diagrams.

The author has thought it expedient and opportune to discuss the nature of this invention, and by showing what modifications it introduces in the operation of the ordinary induction motor, and also by giving a method of calculation for a machine of that type designed to meet certain given requirements.

In order to avoid complicating matters too much at the outset, we will suppose that we are dealing with an ordinary induction motor having a stator winding of negligible ohmic resistance.

We will also assume, and for the same reason, that there is no magnetic leakage, and that the diagram of operation is represented by Fig. 1, wherein, for a motor in normal operation, $O\,A$ represents the magnetizing effect M_2 of the rotor winding, while $A\,B$ represents the magnetizing effect M_1 of the stator winding (the relative directions being indicated by the arrow heads), and, finally, $O\,B$ represents the resultant of these two effects. $O\,B$ will consequently

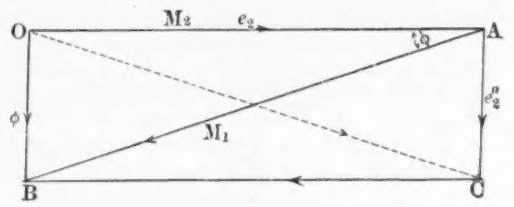


FIG. 1.—DIAGRAM OF OPERATION.

indicate, but according to a different scale, the amount and direction of the resultant single magnetic flux, ϕ, passing through the cores of both the rotor and the stator.

Since the primary current, i_1, is in phase with $A\,B$ (on the assumption that there are no losses in the iron), and since the e.m.f., e_1, induced in the primary winding by the resultant magnetic field, may be represented by a distance on the line $O\,A$, then (the resistance, R_1, being assumed to be negligible) the angle of lag will be represented by the angle $O\,A\,B$.

If we now wish to neutralize this angle of lag, it is indispensable that the straight line, $A\,B$, should become parallel to $O\,A$, or, in other words, that the primary current, i_1, should be in phase with the difference of potential applied at the motor terminals, E_1, whose direction (phase relation) is exactly opposed to that of e_1, the e.m.f. induced by the resultant magnetic field.

But the difference of potential at the motor terminals being constant, such is also, of necessity, the case with e_1, the induced e.m.f., and, consequently, it is also the case with the magnetic field, Φ, which produces this e.m.f.

We know that this magnetic field (Φ) is produced only by the resultant magnetic effects of the primary and secondary windings. It follows that if the current, i_1, or the primary m.m.f., M_1, undergoes a change in phase relation until it is directed along the line $B\,C$, the secondary m.m.f., M_2, will have its inclination changed from $O\,A$ to $O\,C$.

The same result might be obtained if there were sent in the secondary winding, by any means whatsoever, a current, i''_2, whose phase is the same as that of the vector, $A\,C$.

This auxiliary current, i''_2, will combine with the current, i'_2, produced by the resultant magnetic field, Φ, to give, in the rotor, a resultant magnetizing effect, represented in magnitude and in direction by $O\,C$.

It would seem, at first glance, as if we should arrive at the same result by producing the magnetizing effect $A\,C$ in the stator.

Such is not the case, however; for the diagram shows, in fact, that the lag of the current $B\,C$ would be 0°, while that of the current

* Reprint of a chapter specially written for the American edition of the author's work on "Induction Motors," a translation of which book by Mr. C. O. Mailloux is now on the press.

$A\,C$ would, on the contrary, be 90°.

The resultant of these two currents would be $B\,A$, and the final power factor would be

$$cos\ \phi = cos\ O\,A\,B,$$

as before. Nothing would, therefore, have been gained thereby.

The current $B\,C$ would, by itself, produce the whole output, while the current $A\,C$ would produce the resultant magnetic field, the magnetizing effect of the secondary being, all the time, neutralized by that of the primary component, $B\,C$.

We will see, later on, that by producing, in the rotor, the fictitious magnetic flux, $A\,C$, the result is no longer the same.

Let us first note that if we want the torque to be the same as it was before changing anything in the machine, the point C must be placed at the intersection of the straight line, $B\,C$ (which is parallel, to $O\,A$), and of the straight line, $A\,C$ (which must retain the same direction as $O\,B$).

The pull producing the torque is, in fact, proportional to the product of the magnetic field by that component of the resultant current of the rotor, which is perpendicular thereto. This pull is, therefore, proportional to the area of the triangles such as $O\,B\,A$ and $O\,B\,C$.

We might also reason in the following manner:

Since the lag must pass from ϕ° to 0°, we must have for the same output $B\,C = A\,B\ cos\ \phi$. The diagram, $O\,A\,C\,B$, is, therefore, a rectangle.

It is evident that the application of the Heyland principle will not modify, in any respect, the importance of the slip.

In order to introduce the current i_1'' into the secondary, the inventor has made use of a rotor arranged like the armature of a direct-current dynamo; that is to say, provided with an ordinary wave winding and with a commutator.

By applying to this commutator three sets of brushes placed 120° apart, it is possible to produce, in the armature, the effect of a three-phase winding with delta connection, which will remain fixed in space, notwithstanding the rotation of the conductors. On the end of the rotor opposite to the commutator, the winding is connected, at three points, to three collector rings; hence, if we remove the three sets of brushes, above mentioned, there remains only the armature of an ordinary induction motor.

The same rotor winding is thus made to combine the characteristic features of two distinct windings.

It is evident that in analyzing what takes place, we can study separately the effects of the two windings thus arranged, and then superpose the results.

The "first winding," being the ordinary winding, which connects with the three collector rings and which is already well known, will not require extended study.

It is not at all fixed in space, but takes part in the rotation of the rotor. It therefore slips slowly in the magnetic field of the air-gap and produces a reaction, or, to put it differently, a fictitious flux, $O\,A$, which moves with the same speed as that of the stator field, and which, naturally, has an equal number of poles.

In thus slipping in the field $O\,B$, it gives rise to an e.m.f., e_2', producing, in each of the three branches, a current,

$$i_2' = \frac{e_2}{R_2}$$

In this equation, R_2 = the ohmic resistance of each winding, and e'_2 is given by the well-known relation,

$$e_2' = 0.826\ Z\,B\,L\,V\ 10^{-8}\ \text{volts},$$

wherein

Z = the number of actual conductors connected in series, in each phase,

B = the effective density of the magnetic field of the air-gap, in gausses,

L = the axial length of the core of the rotor in cm,

V = the peripheral velocity of the rotor in cm per second, and

0.826 = a coefficient which applies to three-phase armatures having wave windings.

The fictitious flux produced by the reaction of this winding would cause, in the air-gap, an effective magnetic density,

$$B = \frac{S \times i_2'}{3\ p \times d}\ \text{gausses},$$

where

S = the total number of active conductors of the rotor,

p = the number of poles,

i_2' = the effective current, in amperes, in each of these conductors,

d = the (radial) distance across the air-gap, in cm, slightly increased to make up for the reluctance of the iron, and for the openings (slits) between the outer ends of the teeth of the cores.

The "second winding" is the same as a winding having delta connection, owing to the three sets of fixed brushes.

As already stated, this winding is the same as if fixed in space; and its position is, therefore, independent of the rotation of the armature (rotor).

Since the brushes are supplied by the same source of current as the winding of the stator, this rotor winding tends to produce a magnetic flux, revolving with the same velocity as that of the stator, or that in the air-gap, which is the only magnetic field resulting from the combination of all the magnetizing effects brought into play.

Since each of the branches of the second winding has a number of active sides equal to that of the pnases of the first winding, the e.m.f. induced by the magnetic field of the air-gap will be the same in both cases, for the velocity of the conductors in this magnetic field always remains equal to that of the slip.

The currents in this second winding are naturally in phase with the reaction $A\,C$, whose direction is that of the magnetic flux, $O\,B$, in the air-gap.

It follows that the e.m.f. induced by the magnetic field in this second winding will have a lag of a quarter of a phase behind $A\,C$, and its direction will be along the line $A\,D$ (Fig. 2).

If we plot the values of the product $i''R_2$, along $A\,C$, according

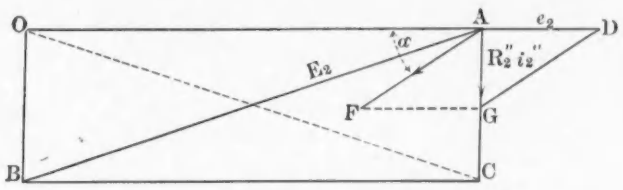


FIG. 2.—DIAGRAM OF OPERATION.

to the scale of volts, we will find, by completing the parallelogram of vectors, the magnitude and direction of the e.m.f. which should be applied to the brushes in order to produce the required current, i_2'', in the second winding aforesaid.

The potential difference, E_2, applied at the brushes, however, is obtained from the primary source of current, and, consequently, cannot have any phase difference with respect to the right line, $O\,A$, which indicates the phase of the primary current at the instant of time under consideration. The e.m.f., E_2, as indicated in Fig. 2, lags by an amount equal to the angle $O\,A\,F$ behind the e.m.f. in the primary circuit.

Automatic Telephony at Westerly, R. I.

The Westerly Automatic Telephone Company has issued lately the following data about its work and progress:

A little over a year ago, when the Automatic Company was first proposed, the Providence (Bell) Company had about 75 subscribers in Westerly. By a reduction of 25 per cent on all rentals and vigorous canvassing it increased its exchange list to about 110 subscribers in Westerly, with rates ranging from $18 upward. The Automatic Company's rates are $20 for house, and $30 for business telephones. To-day the Automatic Company has 180 subscribers connected, with 200 names on the list and additional ones constantly coming in.

The entire capital stock, $25,000, was underwritten at the start, but the project has grown so rapidly away from and beyond the original expectations that the company has petitioned the Legislature for right to increase its capital stock from $25,000 to $100,000. In addition to our own pole lines throughout the town equipped with ample cable capacity and with strictly first-class construction, the company has built five miles of line to Watch Hill, and has obtained from the town the right to build to Noyes Beach (Weekapaug, six miles), where connections will be made with lines to Narragansett Pier and Peacedale. The company has petitioned for rights to build a line through Potter Hill, Ashaway, Niantic, Wood

River Junction and Carolina to Kenyon (17 miles), a very prosperous territory now entirely without telephone facilities.

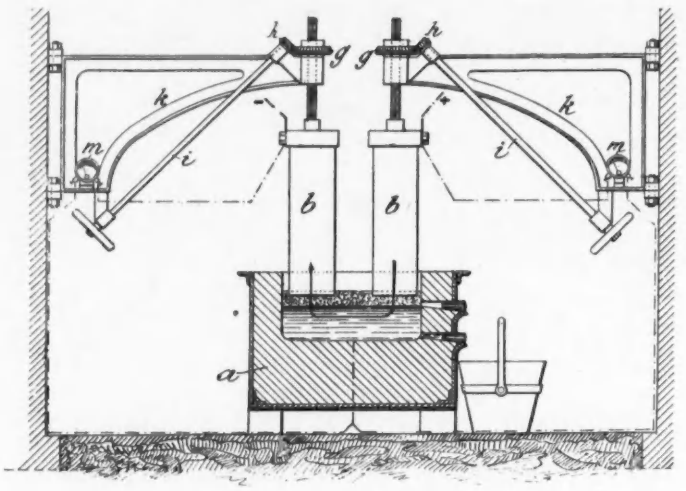
A careful estimate of the reasonable expectations of the business actually in sight is, that by next summer, when the Watch Hill subexchange and the country toll lines are in operation, the company will have at least 300 subscribers on its exchange list. The gratifying promptness with which the quarterly rental bills are paid in advance fully confirms the universal expression of entire satisfaction with the quality of the service.

Recent Electrochemical Developments.

BY CLINTON PAUL TOWNSEND.

ELECTRIC FURNACE.

In general construction an electric furnace recently patented by M. Paul Louis Toussaint Héroult follows the lines of the early device of Slawianoff. That is to say, it comprises a crucible for containing molten metal, two electrodes above the surface of the metal, and electrical connections for striking two arcs in series. The electrodes are separately adjustable, and two voltmeters are used for the guidance of the operator in controlling the resistance between either carbon and the bath. The accompanying diagram shows a crucible, *a*, provided with a tap hole and slag spout, and two vertical carbons, *b b*, the electrical connections being such that the path of the current is from the first carbon to the bath and from the bath to the second carbon. The electrodes are mounted upon swinging brackets, *k*, and



HÉROULT ELECTRIC FURNACE.

provided with means, *g, h, i,* for their independent manual adjustment. Voltmeters, *m,* are interposed as shown in circuits between each carbon and the bath. The electrical connection of the voltmeter circuits to the bath of molten metal is made through a rod of the same metal projecting through the refractory lining of the crucible; this rod may become fused at its inner end in operation, but the electrical connection is sufficiently maintained.

A layer of slag or ore is shown as overlying the metal and interposed between it and the carbons. The arcs are described as playing through this insulating layer, whereas a truer conception of the action would probably be gained by considering the furnace as of the resistance type, the heat being developed in this slag. The composition of the slag, or rather resistance-heater, should be related in some manner to the process which is being carried out in the furnace. In reducing operations it may be merely the unconverted charge; for dephosphorizing iron it may be the basic reagent of the Thomas' process; and for the production of chromium, nickel or tungsten-steels it may be either a neutral silicate or any basic or acid reagent required for the purification of the metal.

EDISON BATTERY.

The latest modification of the Edison battery comprises insoluble active materials, briquetted and retained in perforated pockets in a metal frame—the construction rendered familiar by the earlier patents. The patent now issued deals particularly with the element, which is oxidized on discharge and reduced in charging. Essentially this element, as now described, consists of the oxide of cobalt, and is produced by the cautious calcination in air of the corresponding oxalate. The conductivity of the oxide being low, it is advisable, for the purpose of insuring the electrical activity of the entire mass, to mingle with it a better conductor, for which purpose mercury, copper or foliated graphite are suggested. If mercury be used it is added as an oxide and reduced in charging the battery, whereas copper is added in finely divided metallic form. The average voltage of such an electrode, opposed in a 20 per cent. caustic potash solution to the electrode heretofore described as consisting of nickel hydroxid and graphite, is given as 1.10.

PLATING BATH.

Josepha Chiele, of Brussels, proposes a new plating bath for an old purpose. As is well known, objection has often been made to the use, particularly in surgical instruments, of an intermediate coating of copper between the steel of the tool and the (usually silver) final coating. A very slight amount of wear upon points or edges will lay bare the intermediate coating, and the toxic qualities of copper render its presence, if not positively injurious, at least undesirable. The substitute metal in the present case is tin, which is said to be deposited from a bath of the particular composition given below in a form which is not only adherent to the steel, but to which, in turn, the silver adheres with all the tenacity which it displays toward copper.

The bath used for electrodepositing tin is made by dissolving in nine liters of water 500 gm of sodium pyrophosphate, and 100 gm of stannous chloride, and adding to this solution 50 gm of aluminum nitrate and an equal quantity of magnesium nitrate dissolved in a liter of water. Anodes of aluminum and tin are used during the plating, and the patentee asserts that both aluminum and magnesium enter into the composition of the deposit and determine its unexpected properties.

Ries Patents Sold at Auction.

At an auction sale in Baltimore, March 3, there were sold in accordance with a court decree, the rights to 47 patents and 18 patent applications in the name of Elias E. Ries, the purchaser being Arthur G. Thompson, of New York, and the price paid, $60,000. The decree followed a lengthy litigation on a bill of complaint of Albert H. Hutchinson, praying for the dissolution of the co-partnership of Ries & Henderson and the liquidation of its affairs by receivers and an accounting of the business by its co-partner, Mr. Ries.

According to the terms of the decree, the patents were first offered by groups, there being 13 groups. The separate bids aggregated $59,700, or $300 less than the bid for the entire lot. There was considerable competition for some of the patents. For those covering conduits for electric and cable railways there was a bid of $10,500 by the United States Electrical and Development Company, which also bid $35,000 for the patents on railway systems, and $12,200 for the patents on induction railway. The distribution of the patents in groups was as follows:

Automatic signaling device for railroads, one patent (1886); electric welding and tempering, 10 patents (1887-1896), and 5 applications (1888-1893); electric riveting, 4 patents (1889-1891); electric soldering, 1 patent (1892); electric heating, 5 patents (1888), and 3 applications (1888); induction coils, generators and motors, 5 patents (1888); overhead conductors for electric railways, 1 patent (1888), and 1 application (1887); brake and traction systems, 4 patents (1887-1891), one of which is subject to a license to the Otis Elevator Company; conduits for electric and cable railways, 8 patents (1886-1889); electric railway systems, 4 patents (1888-1889), and 4 applications (1886-1891); railway systems, transformers, 3 patents (1889-1899), and 2 applications (1887-1889); the 1899 patent is subject to an agreement dated November 22, 1893, between the then owners and Mr. George Westinghouse; induction railway, 1 patent (1891), and 2 applications (1892); apparatus for removing snow and ice from railway tracks, 1 patent (1888).

Almost all of the patents were issued prior to 1889, and therefore have but a short remaining life. The applications are probably all forfeited for lack of prosecution during the statutory period. It is rumored that the purchaser represented one of the large electrical manufacturing companies.

New Telephone Patents.

The Patent Office issue of February 24 is rather noteworthy, as it contained no telephone patents. On the other hand, the issue of the next week, March 3, as if to make up for the previous deficiency, appears with no less than seven such patents. Of these three are for transmitters, an apparently never-failing subject for the efforts of inventors. One of these new transmitters is of the microphone type, one is of the Hunning's or granular type, while the third is nondescript. Two views of each of these transmitters are shown in Fig. 1.

At the left of this figure the new granular transmitter appears. This is the invention of A. F. Lawson, of Buffalo, N. Y., the chief novelty consisting in arranging the button within a resonating chamber partly formed of the diaphragm or diaphragms. The idea is that sound waves of a given intensity passing into the closed chamber will effect a greater change in the transmitter button than they do in the usual types of transmitter where they impinge on the diaphragm from without. The construction is very simple, but the diaphragms appear to be too much exposed to damage from external sources. Damage from any undue internal pressure is guarded against, the milled head adjusting screws acting as stops.

The transmitter in the middle of the figure is an adjustable microphone. Within the usual enclosing shell at the rear of the diaphragm a small carbon cylinder with a hemispherical head is mounted. Just to the rear of this there is mounted upon trunnions a carbon block having a circular aperture rising from the center of the front face to a point somewhat above the center of the rear face. Within this hole a small carbon ball or pellet is placed resting, as shown, partly within the hole and against the rounded end of the carbon cylinder. A loose buffer of cotton wool is put in the hole behind the pellet, to avoid breaking the circuit under excessive excitation. The sensitiveness of the microphone depends upon the initial pressure at the contacts, which may be varied at will in this case by revolving the carbon block upon its trunnions. Thus, for very sensitive working the axis of the ball guide or hole is brought toward the horizontal, and vice versa, the axis is made to approach the vertical as the requirements for volume decrease. Charles Holmok is the inventor of this transmitter.

The third transmitter, that at the right of the figure, is very novel in that no diaphragm is employed. Instead, what the inventor, Mr. Lemuel Mellet, of Somerville, Mass., terms "harmonic vibrators" are provided. These are helical springs tuned to various notes of the scale so that they will take up naturally their fundamentals and overtones and impress them upon the transmitter button, instead of having to be forced into an unnatural vibration, as is the diaphragm of ordinary practice. In the cut springs for two octaves are shown. It seems highly improbable that such a device will transmit speech with great success, although for less complicated vibrations it is conceivable that with proper design it might be made more efficient than the diaphragm transmitter.

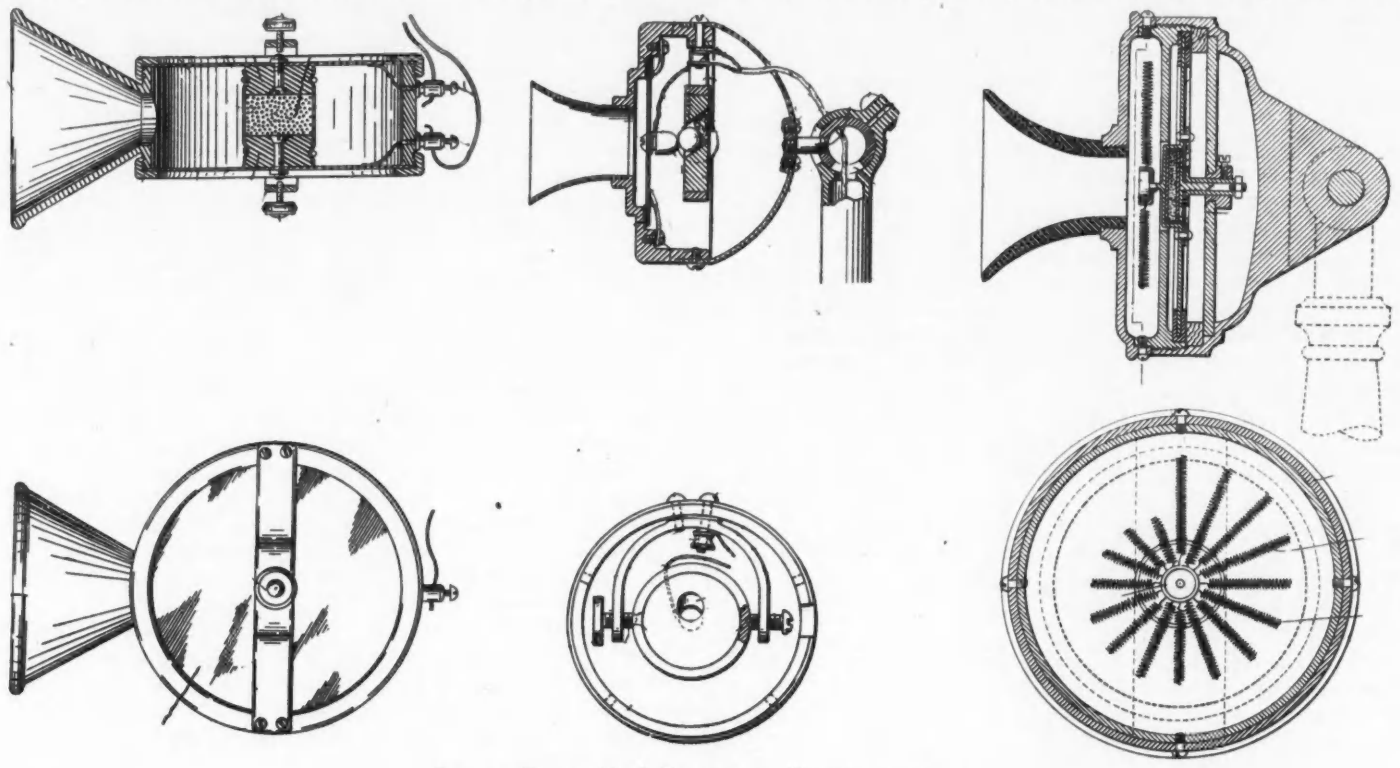


FIG. 1.—THREE NEW TELEPHONE TRANSMITTERS.

In Fig. 2 there is shown the circuit of a delightfully simple central energy system in which with a minimum of apparatus all the signals usual with this type of system are provided. As may be seen from the figure, the transmitter current is fed directly to the subscribers' lines through retardation coils in the form of relays. The talking wires of the cord circuit, therefore, serve merely to loop the two lines together. The signal wire of the cord circuit contains no apparatus but the two supervisory lamps. The operation of the system is as follows: When the subscriber, X, desiring to make a call, removes his receiver from the hook, completing, as usual, a circuit across between the two sides of his line, relays, A', both operate, as both are in series in a battery circuit completed by $X's$ action. The lower relay, A', through its contact, connects $X's$ line lamp to battery, while the upper A' completes the circuit to the grounded side of the battery. The line lamp, L, thus lights, notifying the operator that X desires to talk. Now when the plug, P', is inserted into one of the jacks of line X, in answering, it will be noted that a second circuit from the battery extending through the lamp, L^3, is completed. It will also be noted that this circuit uses the same ground connection as L'. Now this joint use of the ground connection serves to extinguish both lights. This can readily be accomplished by making the lamp for a voltage considerably lower than that of the battery and inserting in the ground connection a controlling resistance, r', of such a size that when in series with one lamp the potential drop within it will be just equal to the difference between the normal lamp voltage and the battery voltage. When the two lamps are in parallel, if the voltages have been properly chosen, neither will get sufficient current to glow on account of the excessive drop in r' under these conditions. Whenever a plug is in the jack and the circuit is not completed at the subscriber's premises, the supervisory light only glows, as while the ground connection remains at the back contact of the unactuated relay, A' (upper), the line lamp circuit is open at the relay, A' (lower).

While the idea of this system is ingenious, it can be improved to advantage. Thus it will be seen that the relay is superfluous, as both its front and back contacts are connected to ground and, therefore, it does nothing in its operation. It would be far better to permanently ground the jack testing rings and combine the two relay windings upon one core, that of A' (lower). Again, condensers should be placed in both talking wires of the connecting cords, for two reasons. First, a good distribution of current to lines of unequal

length would otherwise be impossible; and second, a study of the circuit shows that a busy test is now impossible, as the tip of one of the plugs is connected to battery as soon as the other is inserted in a jack. Further, a reversal of the jack connections to obviate this difficulty, would be of no service, as if the calling station telephone receiver were off the hook, the battery connection would be completed through it to the testing plug tip. Mr. S. B. Fowler is the inventor of this system.

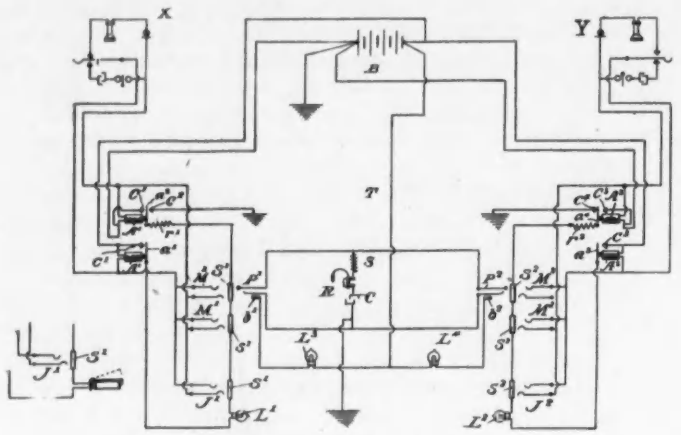


FIG. 2.—FOWLER CENTRAL ENERGY SYSTEM.

Under the title, "Trouble-Test for Automatic Telephone Systems," Frank N. Reeves has patented an attachment for the Faller "mechanical operator," which will call an attendant in case of failure of the machine to operate satisfactorily. In order to explain Mr. Reeves's invention a word about the "mechanical operator" is necessary. This is a machine having among other elements subscribers' line terminals and the equivalent of connecting cords. When a call comes in on one of the lines the machine operator picks it up, receives from automatic devices at the subscriber's station a record of the number desired, selects the line of that number and then connects the two

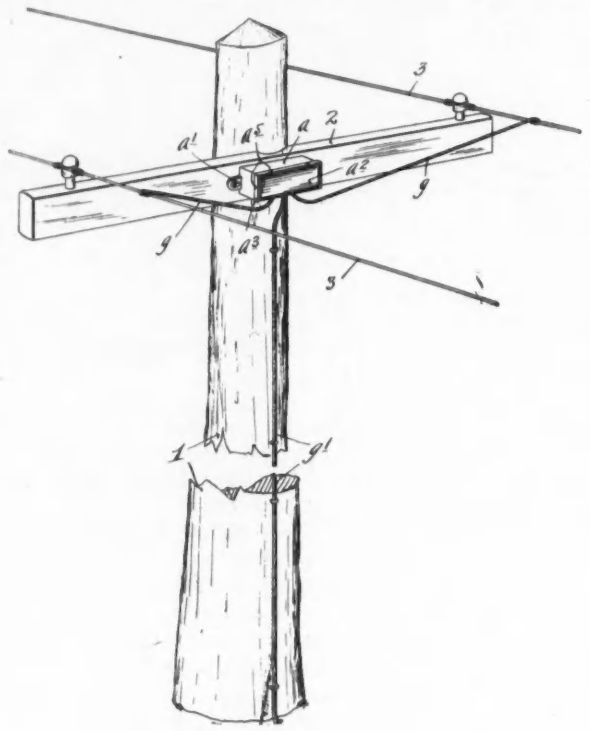


FIG. 3.—CHAPMAN LIGHTNING ARRESTER.

lines to any available pair of connecting cords or, more properly, bars. Now these several operations are all timed and controlled by a master shaft, which, as the machine as a whole is constantly driven at a uniform speed, requires under normal conditions approximately the same length of time to complete each connection.

The present invention is based upon the constancy of this time of connection, and in case the time is too long, indicating trouble, the repair man is automatically called. This is accomplished by providing the master shaft with a cam, the wiper of which, if allowed to descend, will operate a trouble key. The descent of this wiper, however, is controlled by a dash-pot, and under normal shaft rotation it will never descend sufficiently to operate the key. If, on the other hand, the cam stops too long, or goes too slow, the key will be operated. The Faller system has already been described in these pages.

The sixth patent of the present issue describes a lightning arrester or air cut-out for aerial telephone lines exposed to lightning discharges. Within a closed metal box having an insulating bridge, as shown in Fig. 3, there are mounted two carbon discs each with a biserrated face opposed to and a short distance from a carbon slab. Each of the discs is electrically connected to one side of the line to be protected, while the carbon slab is grounded. The arrester is adapted to be mounted upon a pole, in which position the grooves in the carbon plates are well adapted to allow carbon dust generated by the passage of discharges to fall out, thereby removing the resulting accidental ground connection. This patent has been granted to W. J. Chapman.

In the reissued class, W. W. Dean's invention of a busy test system suitable for use with the two-wire central energy switchboards of the Kellogg Company, reappears. As this test system was described under this heading in these columns January 17, 1903, no further mention seems necessary at this time.

Telephony in New Jersey and Long Island.

A number of interesting statements are made by President Cutler in his recent annual report on the affairs of the New York & New Jersey Telephone Company, showing to what extent storms and other disasters may play havoc with telephone lines, if overhead. He says: "The early part of the year 1902 was a season of unusually destructive storms which for a considerable period seriously crippled all overhead telegraph and telephone lines in the territory operated by your company, and entailed heavy expenditures for repairs and replacement of destroyed plant. The disastrous conflagration which swept over the business section of the city of Paterson, N. J., on February 9th, was followed on March 2d by an overflow of the Passaic River, which completely flooded the lower part of the city, causing loss of life and great damage to property. Fortunately, your company's valuable building, lately completed, was situated outside the devastated district, but a considerable amount of the plant in the streets was destroyed or seriously damaged, causing some interruption to service of local subscribers.

"On the night of February 21 the territory was visited by the most destructive sleet storm in the history of the company. The overhead lines of your company, as well as those of the telegraph, electric light and trolley systems, were almost completely prostrated. In the larger nearby cities the damage was much lessened by the predominance of underground lines, but the southern part of New Jersey and the middle section of Long Island were completely cut off from telephone communication for a period of from four to six weeks. While every effort was being put forth to secure an early restoration of the crippled plant, substantially our whole force of linemen left our service without a moment's previous notice, and without any intimation of dissatisfaction on their part. This added greatly to the difficulty and delay in the restoration of service, and to some extent increased the cost of the work. The actual cost of repairing and rebuilding the prostrated lines was $267,505, and the loss of revenue through the interruption of service is estimated at about $100,000. The entire cost of repairs has been charged against the earnings of the year, which fact will account for the large increase in the maintenance account over former years. Under normal conditions the net earnings of the year 1902 should have been at least $365,000 above the amount shown.

"The increase in number of stations served would probably have been considerably larger, as canvassing for new business was necessarily suspended during the time in which the service was interrupted. The last previous sleet storm which seriously affected our business occurred in 1891, in which year we were forced to encroach upon our surplus account to pay our usual dividend rate. Through the use of the underground trunk line leading from Jersey City to Newark your company was enabled to furnish to its patrons uninterrupted communication between New York, Brooklyn, Jersey

City and Newark during the time when other lines were disabled.

Regarding competition, it may be said that while the few unimportant systems heretofore established still keep up a struggling existence, there are no evidences of new life or further development. In fact, on the whole, there are less stations connected to those systems than at the date of our last report.

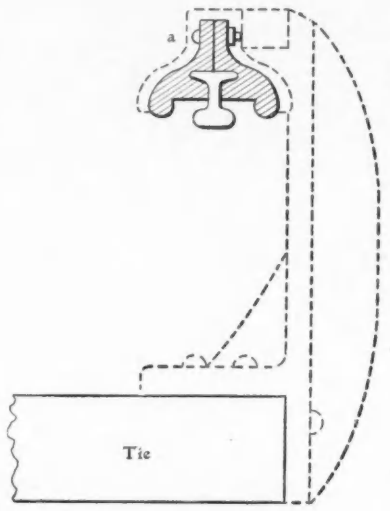
The report of the New York & New Jersey Telephone Company for the year ended December 31, 1902, compares as follows:

	1902.	1901.	Changes.
Gross	$3,962,597	$3,376,432	Inc. $586,165
Operation and maintenance	2,823,458	2,294,633	Inc. 528,825
Net	$1,139,139	$1,081,799	Inc. $57,340
Charges, tax and division	873,977	790,390	Inc. 83,617
Surplus	$265,162	$291,409	Dec. $26,277

The company shows assets of $17,592,792 and a surplus over liabilities of $2,633,181.

Inverted Third Rail Conductor.

The accompanying illustration shows some details of a modification of the inverted third-rail way conductor and trolley recently patented to L. E. W. Walkins. The object of the modification is to fit the system for telephone service to and from moving trains on railways, experiments on which are to be made by one of the large telephone interests. The way conductor is fully protected against weather conditions, such as sleet, snow and rain, which condition was lacking at the tests made during the past winter on the State



INVERTED THIRD RAIL.

Railway near Frankfort, Germany, and on the Dedham branch at West Roxbury, on the New York, New Haven & Hartford Railroad, with corresponding unfavorable results.

The inventor claims that tests he has made show that his inverted third-rail system can be used for railway train telephone and signal purposes with results of a very satisfactory character. Plans which have been prepared for installation show that it will not be costly to install in blocks of five or ten miles in length, using a composition iron bracket made by a Taunton iron foundry. The insulation of the inverted third rail is accomplished by a cheap yet efficient insulated hood containing no iron or other metal, made in lengths of 15 ft. each and bolted together every 8 inches.

Michigan Independent Telephone Companies.

Managers of many of the independent telephone companies in Michigan, to the number of 70, met at Lansing on February 26. President J. B. Ware delivered an address in which he reviewed the progress made by the independent companies in Michigan and elsewhere, and declared that everything was in a condition highly satisfactory to the independent interests.

Mr. R. F. Johnson, of Saginaw, read a paper in which he favored a clearing house similar to the system employed by banks, where the toll-line accounts of the companies might be adjusted. Mr. C. E. Tarte, of Grand Rapids, advocated establishing night rates, and Mr. S. E. Parkill, of Owosso, discussed the necessity for independent connection with the business houses of Detroit. Mr. H. E. Adams, of Toledo, described the Toledo independent exchange, and Mr. W. O. Hunt, of Adrian, discussed Rural Telephone Business. A discussion followed the reading of the various papers, and the meeting was considered a profitable one to all concerned. Mr. E. B. Fisher, of Grand Rapids, was elected president of the association, Mr. C. F. Brown, of Alma, secretary, and R. F. Johnson, of Saginaw, treasurer.

Central Missouri Telephone Association.

The Central Missouri Telephone Association, comprising all of the independent telephone lines of Missouri and Western Kansas, held its annual convention at Sedalia, Mo., February 27. President G. W. Schweer, of Windsor, presided over the meeting. Delegates were present from St. Louis, Kansas City, St. Joseph, Western Kansas and Missouri towns. The chief work accomplished was the perfecting of plans for long-distance metallic connections between St. Louis, Kansas City and intermediate points, with connecting lines, including scores of farm circuits. Rules and regulations were also adopted governing the independent companies in the associations.

The following-named officers were elected for the year: President, G. W. Schweer, Windsor; vice-president, F. A. Churchill, Sedalia; second vice-president, W. B. Scruggs, Harrisonville; secretary, M. L. Golladay, Holden; treasurer, C. E. Betts, Fayette.

Method of Making Rates at Cleveland, Ohio.

The Cleveland Electric Illuminating Company charges for current on what it terms a "two-rate" system. This is not the two-rate meter system with which readers of this paper are probably familiar, but derives the name "two-rate" from the fact that electrical energy is charged for at one rate until an amount of electrical energy has been used equivalent to burning all of the lamps a certain number of hours. The rates are 12½ cents per kilowatt-hour, until an amount of electrical energy has been used equivalent to burning all of the lamps connected to the meter fifty hours in each month. The rate is 5 cents per kilowatt-hour for all energy used in excess of that amount. As in any other meter system, the customer pays for only the actual amount of current used. The fifty-hour use rule simply specifies the amount of electricity to be used at the regular rate of 12½ cents, before the five-cent rate begins to apply. This arrangement, however, is somewhat modified for residence lighting. In making the residence rate only 40 per cent. of the lamps connected to the meter are counted as a connected load, from which to calculate the fifty hours' use per lamp, upon which the two-rate system is based. This is considered fair to both customer and company, because a residence seldom has all the lamps in it lighted at the same time. On special occasions a large number of the lamps are lighted simultaneously; but experience shows that when such is the case less than the usual amount of light is used in several other houses; and for this reason only 40 per cent. of the lamps connected to the meter are reckoned as connected load in making the meter rate. Further than this, lamps connected in closets, servants' quarters, attic and basement, are left out of the residence count.

In making up the residence rating a card is used, on which are marked the lamps affecting the residence rating, and the lamps, heating pads, flat-iron heating, etc., which do not affect the rating. Mr. Scovil, vice-president of the company, has given the question of rates much thought, and has some clear and forcible ways of presenting the justice of a system of rates where the investment and readiness-to-serve charges are properly taken care of.

The literature prepared by Mr. Scovil for public distribution in connection with this work is very interesting, and explains to the customer the idea of the separate cost of "getting ready" to do business and the further cost of supplying service or the "actual making" cost of current—coal, labor, oil and other elements.

CURRENT NEWS AND NOTES.

MASTERS OF DEPORTMENT.—The Brooklyn Rapid Transit Company has issued a circular to the guards, conductors and motormen in its employ urging courtesy and helpfulness to all passengers.

LIMA (PERU) TROLLEYS.—It is stated that a concession from the Peruvian Government has recently been applied for by capitalists at that city for a system of electric tramways between the watering places of Miraflores, Barranco, and Chorillos, and to connect them with Lima. It is proposed to lay a double track for the whole distance, about 26 km (16 miles).

THE UNIVERSITY OF CINCINNATI has been developing its engineering departments during the last three years, and this year graduates its first class in electrical engineering. The equipment in this department includes a standardizing laboratory, in which it is expected to do calibrating on a commercial scale, the lack of facilities for calibrating having been greatly felt, in the past, by the many electrical companies located in Cincinnati and vicinity.

MARCONI WIRELESS TELEGRAPHY IN ENGLAND.—Arrangements have been concluded, at last, between the British Government postal telegraph lines and the Marconi wireless system whereby business will be interchanged between the government lines and the Marconi stations. This will enable the Marconi system to transmit messages direct from any interior point in Great Britain to Canada and the United States without delay, as soon as the Poldhu station is equipped for long-distance transmission.

ELECTRIC BILLIARDS, as played in Paris, should interest American electrical votaries of the cue. The game is said to be played on a table, in the center of which is placed a plate of some easily electrified material. The billiard balls are of compressed pitch, and the cue is a short rod with a cork tip, prepared chemically. The balls are of course subject to the influence of the electrified plate in the center of the table, and owing to this fact it is difficult to make caroms. It is said to be purely a game of skill, which is likely to become popular among billiard players who are thirsting for new difficulties to conquer.

PENSIONS FOR PROFESSORS.—Announcement is made of a plan for pensioning Cornell University professors who are to be retired after attaining the age of 70 years. One hundred and fifty thousand dollars has been given the university for this purpose, and this amount will be placed at compound interest until 1914, when it will amount to $250,000. Each professor retired will receive an annual pension of $1,500, three-fourths of which will be paid from the pension fund and one-fourth of which will be contributed by the professors. It is expected, however, that professors who reach the age limit before 1914 will also receive the benefits of the pension scheme.

LACHINE RAPIDS PLANT.—The annual report of the Lachine Rapids Hydraulic & Land Company shows that at the end of 1902 the circuits of the system carried 71,500 incandescent lamps, 205 arc lamps and motors aggregating 2,716 hp. Exclusive control has been secured of the power transmitted from Shawinigan Falls to Montreal for a period of 25 years, with right of renewal. A section of the report is devoted to inspection, from which it appears that the company makes its own inspections of interior wiring. During the year 364 consumers have consented to repair defects pointed out, while 36 have refused to do so. Complaint is made of dereliction on the part of insurance companies, which necessitates the company having its own inspection service.

CHICAGO ELECTRICAL ASSOCIATION DINNER.—About forty-five members and guests of the Chicago Electrical Association met for an informal dinner at the Albion Cafè, Pullman Building, on the evening of March 6. After dinner Mr. S. G. McMeen gave a few minutes talk on "Middle West Engineering: An Optimist's View." Mr. McMeen's address was both thoughtful and witty, giving the young engineers present something to think of and something to laugh about, The evening was very much enjoyed by all those attending and gave an opportunity for social intercourse and better acquaintance between members not afforded by the regular meetings. The next meeting will be held Friday evening, March 20, at 1736 Monadnock Building, when S. J. Larned, general superintendent of the Chicago Telephone Company, will lecture on telephone service.

NEW YORK ELECTRICAL SOCIETY.—The 233rd meeting of the society will be held in the lecture room of the American Institute, 19 West Forty-fourth Street, Wednesday, March 18, at 8 P. M. Prof. R. H. Thurston, of Cornell University, will lecture on "The Steam Turbine to Date." Prof. Thurston will give the members of the society a definite and invaluable review of the actualities and possibilities of the situation. The course of the argument will comprise: 1. The beginnings of the steam turbine. 2. The fundamental ideas of its theory. 3. The turbine is not a thermodynamic machine. 4. The economies and the wastes of the turbine. 5. The present status of the machine in design. 6. Simple vs. compound turbines. 7. Performance of the turbine to date. 8. Opportunities for Improvement. 9. Characteristic advantages. 10. Trend and promise for the immediate future. The lecture will be illustrated by lantern.

POPOFF COHERER.—Prof. Popoff, of Cronstadt, Russia, who made perhaps the first practical application of the coherer, was granted March 3 a patent on what is described as a self-decohering coherer system. The end electrodes of the usual glass coherer tube contain each a metallic pin, one being displaced above and the other below the axis of the tube, and overlapping each other about one-half the length of the tube, but slightly separated. There are three insulating partitions in the tube, one at the end of each pin and the third midway between. The chambers thus formed contain a granular filling consisting of grains of hard steel having their surfaces of various degrees of oxidation; or steel grains having portions of their surfaces smooth and polished and portions angular with fractured cleavage; or crushed steel beads, which retain their rounded polished surfaces as well as the acquired angular fractured surfaces. A coherer thus constructed is stated to regain its sensitiveness without any shock or being tapped.

NEW YORK FRANCHISE VALUES.—Transportation and lighting companies furnish the chief values which resulted in the increase from $220,620,155 to $235,142,825 in the valuations of special franchises in New York City by the State Tax Board. On the larger corporations these advances were made: Brooklyn City Railway, from $11,109,000 to $12,502,000; Brooklyn Union Elevated, from $5,485,000 to $6,125,000; Broadway line, Manhattan, from $6,359,000 to $6,540,000; Metropolitan franchise, as it existed before consolidation, from $16,110,000 to $18,413,000; Third Avenue line, from $10,086,000 to $10,316,000; Manhattan Elevated line, from $44,600,500 to $47,100,000; Brooklyn Union Gas Company, from $8,724,450 to $9,350,000; Consolidated Gas Company, from $16,275,000 to $17,985,000; New York Edison Company, from $9,610,000 to $10,175,000; New Amsterdam Gas Company, from $4,413,000 to $4,505,000. The State Board of Tax Commissioners has valued the franchises at their full value, instead of following the rule of local assessors in placing a valuation on other classes of real estate, and in some cases assessing franchises at only a certain percentage of their valuation.

WIRELESS TELEGRAPHY IN ALASKA.—It is stated that after waiting nearly a year for the Marconi Wireless Co. to inaugurate its system in Alaska in accordance with the bid submitted to the Signal Corps, Gen. Greely has decided to give them one more opportunity and will call upon them to immediately install their apparatus. In the event of continued failure, the contract will be annulled. Notwithstanding the apparent success of the wireless system commercially, none of the companies offering to install a system between Cape Nome and St. Michaels in Alaska has succeeded in getting its system to work. Officers of the Signal Corps say that the De Forest Company has given some evidence of sincerity in its proposal, but that up to the present time Marconi has accomplished nothing so far as the Alaska wireless proposition is concerned. Unless some one of the companies succeeds within a short time, it is the intention of the Signal Corps to establish its own system, and the officers are of the opinion that it will give satisfaction, as it has already worked well between the army posts about San Francisco. Meantime a contract has been awarded for the cable to be laid between Seattle and Sitka, a distance of 1,100 miles, and from Sitka to Juneau.

GERMAN ATLANTIC STEAMERS are the subject of an appreciative note, as to their electrical equipment, from Mr. E. L. Harris, commercial agent at Eibenstock, Germany, to the United States State Department. It will be remembered that some time ago we described and illustrated the power and lighting plant on board the "Deutschland." As to the "Kronprinz Wilhelm" it is stated that she has 59 power motors for various purposes, and has 104 electric heaters in her first class cabins.

GUTTA-PERCHA IN GERMAN NEW GUINEA.—Under date of February 3, 1903, Consul-General O. J. D. Hughes writes from Coburg: Gutta-percha trees of a very good quality have just been discovered in abundance in German New Guinea. These are said to yield an excellent quality, equal to "gutta merah" and the other finer grades. Samples sent for analysis to Germany are now undergoing a detailed technical investigation. It is already being predicted that in future German New Guinea will supply the trade with appreciable quantities of gutta-percha, which will be welcome news to the cable industry, the supply of the better qualities having steadily declined. Mr. Oldemeyer, the discoverer, secures the prize of $750 offered by a Bremen merchant to the explorer finding a wild gutta plant in any of the German colonies.

LETTERS TO THE EDITORS.

Three-Phase Measurements.

To the Editors of Electrical World and Engineer:

SIRS: I should like to ask some further information concerning the article on "Three-Phase Measurements," by Mr. Leslie L. Perry, which appeared in your issue of January 10.

Referring to Fig. 4 of the article (appearing herewith as Fig. 1), the projections of the three-current vectors upon the delta of the e.m.fs scale are approximately as follows:

$a_2o_1 = 10.4 \quad a_3o_2 = 25.7 \quad b_1o_1 = 33.4$
$c_2o_3 = 43.6 \quad b_3o_3 = 28.4 \quad c_1o_2 = 20.9$

Mr. Perry's values are given as

$a_2o_1 = 33.8 \quad a_3o_2 = 10.4 \quad b_1o_1 = 26.3$
$c_2o_3 = 20.2 \quad b_3o_3 = 43.6 \quad c_1o_2 = 27.7$

It will be noticed that that these do not correspond even roughly with the scaled values, although the totals of both sets taken in properly selected groups of two are equal within about 2 per cent. If Mr. Perry's values are correct, how are they obtained? Certainly not by "projecting the currents on their corresponding voltages as we did before," that is, under non-inductive conditions. Again, how can the value of the projection a_2o_1 ever equal 33.8 amp when the value of the vector itself, $o\,a$, is only 26.45 amp? I have tried to apply the method for determining the power factor of some unbalanced three-phase circuits and have been confronted with the following conditions:

Upon superposing the Y of the currents upon the delta of the e.m.fs and measuring by this means the power under non-inductive conditions, I have found that the power thus determined was less than the sum of the wattmeter readings taken simultaneously with the current and the voltage readings; in other words, the power factor was greater than unity. Here are a few of the cases:

Ampere per phase			Volts bet.	Kilowatts
A	B	C	phases.	by wattmeters.
34	25	10	2280	115.2
18	13	10	2280	79.2
20	26	21	2280	136.8

In the first of these, for instance, the three sums of the current projection upon the delta of the e.m.fs taken in proper groups of two was 34.3 amp, which, multiplied by 2,280 volts, gives 78.2 kw, or a power factor of 147.5 per cent., which is absurd. Perhaps Mr. Perry can show me where I am in error, or it may be that the method has a limit and that when the unbalance exceeds a certain amount the method becomes useless.

I am certain that the readings taken are correct within 5 per cent., and that both of the wattmeter readings were positive, so that the error is not due to a power factor of 50 per cent. or under and an arithmetical instead of algebraical addition of the two readings, even with the combined error of 20 per cent. in the readings, the power factor would still be in the neighborhood of 107 per cent.

CLEVELAND, OHIO. H. L. WALLACE.

To the Editors of Electrical World and Engineer:

SIRS: Regarding Mr. H. L. Wallace's questions as to the method of measurement given in my article in your columns, I can readily

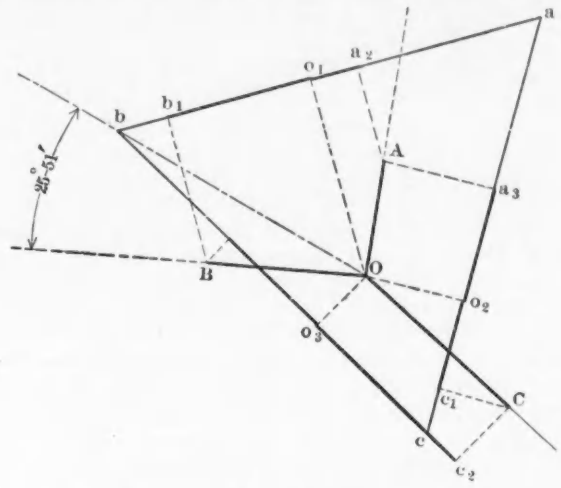


FIG. 1.—CURRENT AND VOLTAGE DIAGRAM.

solve his first difficulty, since it is due to a careless misarrangement of mine in tabulating the results. For Fig. 4 the sets of numerical values should be interchanged to give

$a_2o_1 \times a\,b = 10.4 \times 100 = 1{,}040$
$c_2o_3 \times c\,b = 43.6 \times 100 = 4{,}360 \quad 5{,}400$
$a_3o_2 \times a\,c = 26.3 \times 100 = 2{,}630$
$b_3o_3 \times b\,c = 27.7 \times 100 = 2{,}770 \quad 5{,}400$
$b_1o_1 \times b\,a = 33.8 \times 100 = 3{,}380$
$c_1o_2 \times c\,a = 20.2 \times 100 = 2{,}020 \quad 5{,}400$

With this correction the table and diagram will check.

Instead of applying the method of superposition the following accurate construction may be employed: In the Y diagram of currents (see Fig. 2) calculate angles $A\,O\,B$ and $A\,O\,C$; upon $a\,c$ as a chord construct a circle such that the radial angle $a\,D\,c$ equals to twice

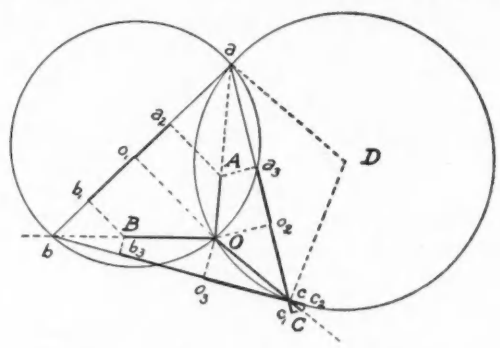


FIG. 2.—CURRENT AND VOLTAGE DIAGRAM.

the angle $A\,O\,C$; then any angle whose vortex is in this circle, and whose base is $a\,c$, will equal $A\,O\,C$. Similarly, on $a\,b$ construct circle $a\,O\,b$, using angle $A\,O\,B$. The intersection of these circles gives the zero point O, and the diagram can then readily be completed. I am confident the method applies to any three-phase circuit, no matter how unbalanced.

If a strictly algebraic method of calculation is desired the formula for $cos\ O\,b\,c$ can be developed from the geometrical construction into

$$cos\ O\,b\,c = \frac{cos\ a\,b\,c - \frac{sin\ a\,b\,c \times sin\ A\,O\,B}{sin\ a\,c\,b \times sin\ A\,O\,C} \times cos\ (a\,c\,b + B\,O\,C)}{\sqrt{1 + \left(\frac{sin\ a\,b\,c \times sin\ A\,O\,B}{sin\ a\,c\,b \times sin\ A\,O\,C}\right)^2 - 2\,\frac{sin\ a\,b\,c \times sin\ A\,O\,B}{sin\ a\,c\,b \times sin\ A\,O\,C} \times cos\ (a\,b\,c + a\,c\,b + B\,O\,C)}}$$

Regarding the particular cases Mr. Wallace cites, I would say that usually it is necessary to measure all three voltages, as a compar-

atively small difference will distort the voltage diagram; and in writing my article I did not show them unbalanced, as I took the figures from Mr. McAllister's article. This may be one source of Mr. Wallace's trouble; but I suspect the kilowatt readings are incorrect, for I note in the second set of readings that assuming a power factor of 100, even were the other two currents equal to the largest, the power would not equal that of the wattmeters.

Thus, $$\frac{18 \times 2{,}280 \times \sqrt{3}}{1{,}000} = 71.1 \text{ kw},$$

as against 79.2 kw indicated by the wattmeters. A similar difficulty is found with the third set.

LESLIE L. PERRY.

NEW YORK, N. Y.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Synchronous Converters for Charging Storage Batteries.—THORNTON, MARCHANT, WOODHOUSE.—Three letters referring to the article of Banti, recently abstracted in the Digest. Thornton discusses the oscillatory effect of armature reaction in sigle-phase synchronous converters, and shows that all phenomena described by Banti can be accounted for by the fact that the magnetic circuit of the machines is too sensitive to variations of armature current, and that the low resistance of the cells facilitates the resultant change in the voltage and current relations in the armature. The conclusion is that for charging storage batteries, care must be taken to prevent the unavoidable impulses of armature reaction disturbing the whole magnetic circuit. This can be most readily done by using solid poles provided with damping coils, for he has observed that short-circuiting the series winding of a converter with solid poles reduced the magnetic oscillations proceeding from armature reaction to a negligible quantity. Marchant explains the effect observed by Banti in the following way: In a synchronous motor or synchronous converter driven by alternating current, the driving torque varies periodically. This varying torque produces a variation in the speed of the converter, so that the generator, representing the direct-current side of the machine, rotates not uniformly but in a series of jerks, the jerks being in most cases imperceptible. This varying speed gives rise to a varying potential difference at the brushes, and if the converter is used to charge storage batteries, any small variations of the voltage produces a comparatively large variation in the current, such as was actually observed. Woodhouse thinks that the real cause lies not with the converter, but with the generator which drives it, and that this pulsation, while magnified by the condenser action of the battery, is in the first place an overtone on the wave of the generator.—Lond. *Elec.*, January 30.

LIGHTS AND LIGHTING.

REFERENCE.

Determining Illumination.—LANSINGH.—A communication illustrated by diagrams, in which he describes an analytical method for determining the illumination on a surface from a given hemispherical candle-power curve of a lamp.—*Eng. News,* February 19.

POWER.

Electric Power for Shops.—FLATHE.—An illustrated article on electric driving of machines. The well-known advantages of the electric drive, are discussed. Concerning the use of individual motors, it is said that for isolated machines and for heavy machines which may be in occasional use, the individual motor is particularly adapted, as it consumes power only when in operation. For ordinary machine-driving, however, especially with small machines, short lengths of light shafting may be frequently employed to good advantage, and the various machines, arranged in groups, may be driven from one motor; by this method fewer motors are required, and each may be so proportioned to the average load that it may run most of the time at its maximum efficiency. Speed control is very often of great importance. The three-wire, 220-volt system offers many advantages both for power and lighting systems, and is very frequently used; variations of speed may be obtained with this system by using a combination of field regulation with either voltage, and, in rarer cases, the use of a double-commutation motor. A method which has been used recently with considerable satisfaction, involves the use of a three-wire generator, with collector rings, connected to an armature winding, similar to that of a two-phase rotary converter. Balancing coils are used, and the middle points of these are connected to the third wire, which is thus maintained at a voltage half way between the outer wires. This system is simple and economical, and possesses all the advantages of the ordinary three-wire method, which permits similar variations in speed by field regulation with either voltage; and if still wider ranges are desired, a double commutator motor may be used. In other recent installations the four-wire, multiple-voltage system is used, which permits of very wide variations of speed in the operation of the tool; its advantages appear to outweigh its drawbacks. In the second part of the article the use of compressed air is discussed.—*Cassier's Mag.*, March.

REFERENCES.

Electric Power in Steel Works.—MACCOUN.—An article on the use of the electric motor in modern steel works and blast furnace plants.—*Sc. Am. Sup.*, March 7.

India.—THOMSON.—An illustrated article on electric power in India, describing the Cauvery Falls plant and the transmission to the Kolar gold fields.—*Cassier's Mag.*, January.

TRACTION.

Steam Railroad Converted to Electric System.—An article on the change of the Cincinnati, Georgetown & Portsmouth Railroad from steam to an electric one, operating with the trolley system. While operated by steam it failed to do much more than pay the operating expenses. When it was decided to change it to an electric system, it was also determined to adopt standard gauge. The road has been completely rebuilt and equipped throughout for electric traction. It operates through a prosperous country and depends largely upon freight business for support. The company conducts its freight and express business on the same lines as steam railroads, but has added some features, such, for example, as regular delivery and collection systems at the important points, which it is hoped will aid in the development of this branch of the business. Sub-stations have been established at several points along the line, and in these are combined the passenger, freight and power plants. In the main power plant two cross-compound condensing engines of 1,400 hp are directly connected to alternating generators of the revolving field type. There is also one engine-driven, 50-kw generator used as an exciter and a motor-driven exciter set of the same capacity. The engine-driven exciter set is used for starting, and when the engines are up to load it is shut down and the motor-driven exciter set is thrown in. There are also two rotary converters in the main power plant and six step-up transformers of 200 kw each. Each of the sub-stations has two 250-kw synchronous converters and three 200-kw step-down transformers, together with the usual switchboard equipment. Each passenger car has four motors. Two large electric locomotives are being built for the purpose of hauling freight trains. They will have a capacity for handling ten loaded cars on a 3 per cent. grade.—*St. R'y Jour.*, February 21.

Third-Rail Operation.—An article on the third rail operation on the Aurora, Elgin & Chicago Railway. Brine is used for cleaning the sleet off the third rail. It is carried in a tank on the front platform and fed to the rail through a rubber tube ¼ in. in diameter. Eight gallons are required for a run of 24 miles. A solution of calcium chloride is to be tried. A new type of shoe consisting of a light bar held down by spring pressure is being used instead of the standard shoe on a few cars. No decision has yet been made as to the method of lighting these cars while passing highways and

other places where the third rail is interrupted. Storage batteries, gas and a short overhead trolley section have been considered.—*St. R'y Jour.*, February 14.

Lancaster.—An illustrated description of the Lancaster (England) electric tramways. The trolley system is used; the power plant contains two 200-kw steam dynamos, two 300-kw steam dynamos, one 60-kw motor generator and one 23-kw balancer. A refuse destructor and boiler is working alongside the station at a steam pressure of 200 pounds per square inch; the steam from the destructor is taken through a reducing valve at a pressure of 135 pounds per square inch.—Lond. *Elec. Rev.*, February 20.

Grades.—HERING.—A table of reduction factors for reducing grades stated in any one kind of units to those stated in the other, the reduction being in almost all cases made by a mere multiplication. This is followed by another table giving the actual numerical equivalents of each grade from 1 to 15 per cent., in all the different units in which grades are stated, thus avoiding all calculations. There are quite a number of different units in terms of which grades are stated, but the more usual and more rational one in the opinion of the author is to give it in per cent., and this unit is made the chief one in his tables, all others being reduced to it. In these tables the reduction factors are given accurately for both the sine and the tangent functions, so that the slight difference between them may be taken into account if desired. Every known method of stating grades is believed to be included, so that a grade stated in any unit can readily be reduced to that in any other. —*St. R'y Jour.*, March 7.

Telephones in Electric Railway Service.—DANIELL.—An article in which the writer says that where there is a good local telephone exchange in the city it is more satisfactory for a company to lease telephone wires from the telephone company than to install its own system. Telephones should be stationed along the lines in locked iron boxes. Keys can then be carried on the cars in a box with a glass over it. Every time a telephone is used the glass must be broken and the key returned in an envelope to the main office. It is necessary to keep a close watch on keys, as instances have been known where keys have been sold to persons living near the pole boxes, who use the telephones and even secure long-distance connections at the expense of the railway company. On a long line telephones can be carried on the car and can be connected to the boxes every ¼ mile on the poles when necessary. Where boxes are carried on poles in this way, they should be so arranged that closing the door opens the circuit to prevent all possibility of lightning entering the instrument. Where a large number of instruments are hired from the telephone company, the usual rental is one-half the regular rates.—*St. R'y Jour.*, February 21.

REFERENCES.

Storage Battery Installation.—A description of the battery installation in the Bordeaux Tramway power plant. The plus end of the battery is connected directly to the plus bar, but the minus end has three connections, so that the two end cells can be thrown on either side of the negative bus as desired. The object of the arrangement is to maintain the load on the generators constant.—*St. R'y Jour.*, March 7.

A Decade of Interurban Railways.—BELL.—A review of the improvements made during the last ten years in interurban practice. These lie in all parts of the equipment; the motor is not only more powerful, but it represents an entirely different type of construction. The third rail has come into general use, and four-axle cars and air brakes are universal.—*St. R'y Jour.*, February 28.

Electric Locomotives.—A description of the electric locomotives used on the Western Railway of France. These locomotives were built to operate between Paris and Versailles and possess a number of novel features, the principal one being that the motors are not connected directly to the axle, but to a hollow shaft which surrounds the axle and is flexibly suspended to it by six helical springs. Both geared and gearless motors are used.—*St. R'y Jour.*, February 28.

Multiple-Unit Trains.—An article on the multiple-unit trains for the Buffalo interurban service. This is the first example of the use of the multiple-unit system in surface railway operation in the United States, and has just been put in operation. As the cars are used for both city and interurban service, a special switch is installed on the cars by which higher speeds can be secured in interurban work.—*St. R'y Jour.*, February 28.

Reducing Congestion.—BELL.—An article in which a number of suggestions are made as to methods for relieving city congestion; stress is laid on the importance of arranging the terminals of the lines so that cars do not interfere with each other.—*St. R'y Jour.*, February 7.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Five-Phase System.—EHNERT.—A mathematical article illustrated by diagrams, on the properties of a five-phase alternating-current system. At the end he gives a numerical example for a comparison of a three-phase and five-phase system, the energy transmitted, the distance, the voltage between the conductors, the loss of energy, and the power factor being assumed equal in both cases. He finds that in the five-phase system the weight of line wire is smaller by 50 per cent.; but the cost for installing and for insulators, etc., is greater; nevertheless he thinks that the resulting saving amounts to 40 per cent. The voltage loss in the line in a five-phase system is smaller than in three-phase. In spite of these advantages, the five-phase system may come into use only for long-distance transmission. The five-phase system would be suitable mainly for motors, but it may also be used for lighting, if a neutral wire is used.—*Zeit. f. Elek.*, February 15.

WIRES, WIRING AND CONDUITS.

Electric Transmission Lines.—ADAMS.—An article in which he compares the relative advantages of different materials for transmission lines. Conductivity is of primary, tensile strength of secondary importance. Aluminum wire requires 1.66 times the section of copper wires for a wire of equal resistance; phosphor bronze, 3.84; iron, 7.14; steel, 9.09. It is not desirable to use a copper wire smaller than No. 4 B. & S. gauge for transmission lines, because of lack of tensile strength in small sizes; when the conductivity of a copper wire smaller than No. 4 is ample, an iron wire will give the required conductivity with a strength far greater than that of the copper. The relative strengths of wires with equal sectional areas compared with soft copper, are for hard-drawn copper 1.32 to 2.06; silicon bronze, 1.76 to 2.94; phosphor bronze, 2.94; iron, 1.62; steel, 2.94; aluminum, 0.88. Comparing wires on the basis of equal resistances for equal lengths, the tensile strength is as follows: A hard-drawn copper line has 2.10 times the strength of a soft copper line; silicon bronze, 6.38; iron, 11.56; steel, 26.70; aluminum, 1.46; phosphor bronze, 11.29. For a line of given cost, length and resistance, soft copper has the least cross-section and tensile strength; steel the greatest cross-section, weight, tensile strength and lowest price per pound; aluminum the least weight and highest price per pound.—*Cassier's Mag.*, March.

REFERENCE.

Line Calculations.—KOENIG.—An article illustrated by diagrams, on a new and more general graphical method of calculating electric lines.—*Elek. Zeit.*, January 28.

ELECTRO-PHYSICS AND MAGNETISM.

Determining Dielectric Constants.—BILLITZER.—A description of a method of determining dielectric constants based upon the fact that in a non-uniform electric field a non-uniform system of dielectric media experiences displacement, since the positions of the system having a greater dielectric constant are subjected to a stronger impulse towards the points of highest potential. The author uses the substance under investigation in the form of a thread or small sphere; he attaches it to a quartz fibre and suspends it in a liquid of known dielectric constant. To avoid polar effects, an alternating current is sent through the liquid by means of two platinum electrodes. The pendulum then shows a deflection unless its dielectric constant is equal to that of the liquid; any liquid may be used which does not attack the body. The author uses a mixture of acetone and hexane in various proportions, which give a variation of the dielectric constant from 2 to 24. If the dielectric constants of liquids are to be determined, various pendulums of known dielectric constants may be used in those liquids. A set of glass pendulums with dielectric constants varying from 4 to 10 may be constructed, and would probably prove very convenient.—*Phys. Zeit.*, February 1; abstracted in Lond. *Elec.*, February 20.

Edison Phenomenon.—ALLEGRETTI.—An account of an experimental investigation of the Edison phenomenon, consisting of the passage of electricity from the extreme negative end of the filament of an incandescent lamp to a metallic plate introduced into the

bulb. According to the author, this phenomenon has not yet been fully explained, although much work has been done upon it by Preece, Fleming and others. The main question is, whether this is a phenomenon of ionization or a true projection of negative particles. The author prepared a special vacuum tube having three openings by means of which the two electrodes and the metallic plate could be easily replaced. He found that the current between the electrode and the metallic plate decreases rapidly as the distance increases, and less rapidly as the area of the plate diminishes. The phenomenon produces no effect upon a sensitive plate wrapped up in black paper. A magnetic field weakens the current perceptibly, especially at the lower pressures. The author believes that the phenomenon is primarily due to ionization, but that at the higher vacua it is enhanced by the production of cathode rays which may be deflected in the same way as the ordinary cathode rays by a magnet.—*Phys. Zeit.*, February 1; abstracted in Lond. *Elec.*, February 20.

Electric Dissipation in Fog.—GOCKEL.—An account of a study of the effect of fog upon the distribution of atmospheric potential and upon the mobility of positive and negative ions. He comes to the conclusion that ascending air currents, such as are prevalent in cyclonic areas, carry with them negative ions. These give rise to the formation of clouds, as a rule, since the negative ions are the most effective condensation nuclei. At Freiburg the author has observed a quicker dissipation of positive electricity with a falling barometer. A surplus of positive ions, as always exists near the mountain tops in fine weather, may be reversed by fog. During snowstorms there is a quicker dissipation of positive electricity and therefore a prevalence of negative ions. The low-lying fogs occurring in autumn and winter are almost always produced by descending air currents, such as prevail during anti-cyclones. These descending air currents take down with them a quantity of positive ions. This gives rise to the strong surplus of positive ions in the layer above the fog, as found by Ebert in his balloon voyages. The author suspects a close relation between dissipation and atmospheric pressure.—*Phys. Zeit.*, February 1; abstracted in Lond. *Elec.*, February 20.

Stationary Wire Waves.—BORGMANN.—A description of a method of producing visible waves along a wire. Arons had devised a method of making wire waves visible by stretching two aluminum wires along a glass tube 2.5 meters long and exhausting the air down to a pressure of a few millimeters. Later Coolidge obtained similar but feebler luminous phenomena in the open air. The present author obtains them on a single wire, mounted along the axis of a tube and connected with the secondary circuit of a Drude apparatus for determining dielectric constants. He used a Tesla transformer and a Blondlot vibrator fed by an induction coil of 3 cm spark length. Spindle-shaped luminosities are seen on the wire itself where the ventral segments of the vibrations are. On varying the position of the first bridge wire, the length of the waves is altered, and hence also the number of luminous stretches on the wire; photographic records can be obtained in about eight minutes; the diameter of the tube is of no consequence. But the tube must not be too highly exhausted, otherwise the glow fills the whole tube, nodes and all. A curious circumstance is that the glow does not set in at once, but two or three minutes after the current has been turned on; the interrupter must work uniformly and rather rapidly, otherwise the phenomenon may fail entirely.—*Phys. Zeit.*, February 1; abstracted in Lond. *Elec.*, February 20.

ELECTRO-CHEMISTRY AND BATTERIES.

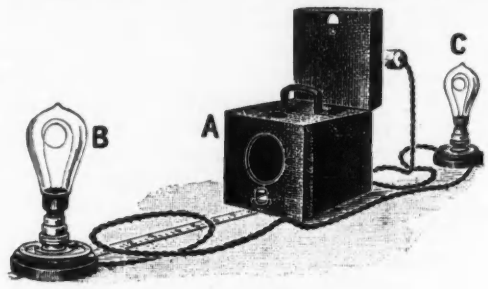
Electrolytic Superoxides.—HOLLARD.—An account of a chemical investigation of the lead peroxide deposited at the anode of a solution of a lead salt. The present author has found that the weight is too great for the peroxide and that higher oxides are deposited; the proportion of these higher oxides is greater the smaller the concentration of the lead in solution. It is probable that very high oxides are formed, but the author has not determined their exact nature. Lead is not the only metal which shows this phenomenon; an alkaline solution of nickel pyrophosphate yields a similar oxide, as does also a solution of sulphate of bismuth containing a little nitric acid and copper sulphate. These have been obtained only in dilute solutions, as the salts are rather insoluble.—*Comptes Rendus*, January 26; abstracted in Lond. *Elec.*, February 20.

Electrons and Ions.—REINGANUM.—An article on the mechanism of electrochemistry; he attempts to formulate a theory of the distribution of the electrons in the molecules entering into electrochemical reactions. He assumes that each molecule, say of H Cl, contains two pairs of electrons, the H atom being provided with one pair and the Cl atom with another pair. Electrolytic "dissociation" might then be represented by the giving off of one negative electron from the H atom to the Cl atom, so that the H atom has now one positive electron, while the Cl ion has one positive electron and two negative electrons, and thus is negatively charged. When Cl is set free at the anode, each Cl ion gives off one negative electron and thus becomes neutral, having one positive and one negative electron; similarly with the H at the cathode. Through the external connection the negative electrons pass from the anode to the cathode, thus completing the circuit. The author works out this idea for the different compounds and shows why the dissociation constant is a measure of chemical affinity. It is probable that the transfer of the supernumerary electron is accomplished even before actual electrolysis takes place.—*Ann. d. Phys.*, No. 2; abstracted in Lond. *Elec.*, February 13.

Change of Volume and E.M.F. with Pressure.—RAMSEY.—An account of an experimental investigation of the change of volume in Clark and cadmium cells and its relation to change of e.m.f. due to pressure. When a Clark or a cadmium cell is put under pressure, its e.m.f. is increased. The values found experimentally for the Clark cell are in good agreement with those calculated, but for the cadmium cell they are smaller than the calculated value.—*Phys. Rev.*, February.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Portable Photometer.—A description of a portable photometer made by an English firm. As shown in the adjoining diagram, the



PORTABLE PHOTOMETER.

standard lamp, *B*, which forms a part of the set, is placed at a point on the graduated tape corresponding to its candle-power. Another lamp, *C*, is then shifted backwards and forwards until the photometer spot, when viewed through the small hole at the top of the box, just disappears. The lamp, *B*, is then removed and replaced by the lamp to be tested, which is in turn moved up and down the tape until balance is again obtained. The reading in the scale under the lamp when in this position will then be the candle-power. As both the lamps, *B* and *C*, are connected in parallel, and therefore are worked at the same voltage, and as the candle-power of an incandescent lamp depends on the voltage, the candle-power of each will increase or decrease in the same proportion for a given change of voltage. Therefore, the candle-power read off on the scale is that which the lamp would give at the voltage for which the standard lamp is marked. Owing to the fact that the standard is only in use for a few minutes at a time, it can be relied upon to keep its candle-power for an indefinite period. The photometer can be used in an ordinary room without any special precautions being taken to exclude stray light. This is because the method amounts to a kind of double weighing, so that the effect of any external light is automatically compensated for.—Lond. *Elec.*, February 20.

Photometry.—An editorial discussion of some points raised in Fleming's recent paper. Attention is called to the uncertainty in the definition of the photometric units. The unit of luminous intensity, which is the fundamental unit, is the candle. A British standard candle is considerably larger than a Hefner candle, the unit used in Germany, and the "bec Carcel," the French official standard, differs from both. The Geneva Congress of 1896 fixed the "bougie decimale" as a unit; this, as Fleming says, is neither a bougie nor decimale, being the twentieth part of the light emitted normally by 1 sq. cm of platinum at its melting point—a difficult and costly standard to reproduce, and one which can only be maintained with absolute accuracy for about one minute at a time. Concerning pho-

tometry itself, the question arises, how are lights of different colors to be compared, for whatever light we take as the standard, other means of illumination will differ from it in color to a greater or less extent. The main question at the moment is how these points are to be decided and by whom. In this respect Germany is in a good position, as it has the Reichsanstalt, and there the Lummer-Brodhun photometer occupies already a semi-official position. Until an international agreement is reached, it is urged that the National Physical Laboratory should supply this want for England.—Lond. *Elec.*, January 30.

Slip of Induction Motors.—MEYNIER.—A description of a new stroboscopic method for measuring the slip of an induction motor. On the axle of the induction motor a circular disk is mounted, one semi-circle being black, the other white. A small synchronous motor is placed so that its shaft is approximately the prolongation of that of the induction motor; on the shaft of this synchronous motor a black semi-circle is mounted. The observer looks on both disks in the direction of the axis. There are two cases, the first being that the rotation of both motors is in the same direction; in this case the observer counts the number of times that the two disks together appear entirely black in a certain time interval; it is easy to count up to 150 such moments in a minute which would correspond to a 10 per cent. slip of a 4-pole, 50-periods motor. For very small slips the full disk of the induction motor may be divided into two n sectors, black and white, and the axis of the synchronous motor bears n black sectors, corresponding to the white sectors of the other disk. The second case is that both motors rotate in opposite directions; here the observer sees a cross, the number of arms depending on the number of sectors; two white and two black sectors give an ordinary cross. For synchronism this cross is fixed in space, while for any slip it rotates, and it will revolve through 180° when the number of turns differs by 1 revolution.—*L'Ind. Elec.*, December 25.

An Optical Pyrometer.—HOLBORN AND KURLBAUM.—A description of an instrument consisting of a telescope which produces an image of the source under investigation in the plane of vision, in which is also mounted the filament of an incandescent lamp. Under ordinary circumstances a simple red surface is seen through the eyepieces owing to a red glass which is inserted, and on it is seen the black filament. The lamp current is then increased until the filament can be no longer distinguished. The photometer or pyrometer is calibrated by means of a radiating black body, as described by Lummer and Pringheim.—*Ann. d. Phys.*, No. 2; abstracted in Lond. *Elec.*, February 20.

TELEGRAPHY, TELEPHONY AND SIGNALS.

REFERENCE.

Telephone Tunnels.—A well illustrated article on the methods of work adopted in constructing the network of tunnels, aggregating 60 miles in length, in down-town Chicago.—*Eng. News*, February 19.

MISCELLANEOUS.

Metric System.—An account of a long discussion before the (Brit.) Institution of Elec. Eng. on the question of the introduction of the metric system. There were numerous speeches on both sides. —Lond. *Eng'ing*, January 30 and February 13.

The discussion is summarized in a long editorial and it said that with the exception of Alexander Siemens' speeches in favor of the metric system, the discussion consisted more of statements of individual likes and dislikes than of arguments. The two arguments raised by speakers against the metric system were, first, that it is less costly to bear the evils we have than those involved in a change, and second, that if it is necessary to abandon the present system, we might adopt one that involved less dislocation of our ideas and habits than the metric system. Parker advocated a system founded on the inch and on the weight of the cubic inch of water. Stoney suggested that a meter of 40 in. should be adopted to render it possible to convert inches into meters without awkward decimals. Editorially it is pointed out that the needs of the export trade will necessitate the introduction of the metric system. To the engineer the introduction bears two aspects, according as he views it as a professional man or a manufacturer; to the former it offers enormous advantages; the manufacturer has large sums invested in linear measures, but these sums should not be exaggerated. "There are many works that would be the gainers for a wholesale scrapping of patterns and the introduction of new ones." But really there are very few cases that a pattern will not serve equally well for either system. "When our American friends have overstocked their home market and turn to export, it will not take them long to decide if a change is necessary; and if they do so decide, they will make it without unnecessary delay, whatever it may cost. It will be somewhat late for us to follow them then."—Lond. *Eng'ing*, February 20.—The speech by which Siemens opened the discussion and advocated the compulsory adoption of the metric system, is reprinted in full in Lond. *Elec.*, February 20.

Electric Heating Apparatus.—A note on a new form of electric heating apparatus, designed by Rivers. With a view to obtaining a large heating surface at a moderate temperature, a layer of very fine carbon powder is held between two enamelled iron plates and retained in position by a bordering of asbestos cardboard. Copper strips are led in, one at either end of the plates and a third in the center, and continuous current at 200 volts is then passed from the latter to the former. The bolting together of the plates gives the requisite amount of compression to the carbon, which is said to be an important feature. The first radiator built was in the nature of an experiment, and had an effective heating surface of 25 sq. ft., the average temperature of the plates being 190° F. The average current taken is 8 amp at 200 volts.—Lond. *Elec.*, February 13.

New Books.

ALTERNATING CURRENT MACHINES. By Samuel Sheldon, Ph. D., and Hobart Mason, E. E. New York: D. Van Nostrand Company. Pages, iv-259. Price, $2.50.

This little work is a real addition to the text-book literature of electricity. It is a companion volume to "Dynamo-Electric Machinery," published two years since, and follows for alternating-current machinery, practically the same line of treatment and arrangement. The book will decidedly fill a place especially its own, and meet a real want which so far there has been no serious attempt to satisfy. It is not so scholarly a work as that by Franklin and Williamson, but it will prove of service to those who find the other work too advanced and exhaustive.

The book is marred by the authors' abrupt and nervous style, though the materials have been selected with excellent judgment and a concise knowledge of the requirements of practice. This second volume of the serial possesses decidedly more merit than the first, and takes rather more advanced ground in its treatment. The subject is a difficult one to present adequately within the narrow limits of this little book, for the range of topics is not only large and their literature voluminous, but there are numerous and widely different methods for their discussion.

The preface states that "the use of all methods in connection with every point, leads to complexity." The earlier text-books on this subject, not properly recognizing this, confused the reader and left the impression that their authors were not clear in their own grasp of the theory attempted. The result was an uncoordinated mass, which obscured rather than elucidated, and left the student with no means of employing principles in practice. In the present case the authors have selected the method which they judged clearest and most concise, with the result that they have written an excellent, practical and clearly discussed book. A happy omission on their part has been the non-use of the complex imaginary quantity both in discussion and problems. However interesting such methods are to advanced students, and in despite of the overzealous insistence of a few writers, complex quantities are superficial, indirect, and do not lend themselves to a true, physical analysis of alternating-current phenomena. They are a clever shorthand medium for treating problems and theory, but they lack a vital connection between the process and the fact, and cannot be rationally practical. Insistence upon their use in technical text-books adds complexity with no gain in power.

The authors do not hesitate to employ concise mathematical discussion where he considers it essential. The book frequently resorts to the analysis of the calculus, but the processes are usually indicated with such clearness that the mathematics of the book should present no difficulties. Occasionally there is an abrupt statement of an equation, or its modification is given with too much brevity.

The book is admirably adapted for reference and the use of students in advanced manual training schools, or the more elementary of the schools of technology. The selection of matter, the lucid treatment and the intensely practical spirit that pervades the book, have combined to produce one of the most excellent of recent text-books,

however much it is out of sympathy with more thorough scholarship. This latter defect will make it of transient value where its method should warrant it a more permanent place.

The matter of the book is of such an elementary and well-established character, that it does not require an extended notice. The properties of the alternating current and the alternating-current circuit are presented in the opening chapters. Since the author has resorted to concise mathematical treatment, it is singular that he has omitted the statement of the formal fundamental equations of harmonic circuits. The various terms in these equations are given and applied, but the book would have gained much in force had the author not been so hasty and brief at this point in his work. This discussion is followed by the conventional chapter of problems, which is excellent in its way but rather too brief. There is too little numerical illustration to make the application of formulas clear, but the reader is relieved at not finding the customary array of exercises for solution.

The chapter on alternators is suggestive, but scarcely adequate and fails decidedly to sustain the method intended by the plan of the book. Where it should be precise, it is descriptive, and beyond presenting the most rudimentary elements of this class of electrical machinery, it leaves the reader with no comprehensive and but little practical knowledge. As an illustration, the topic on armature reaction gives no means for ascertaining this quantity numerically, and merely describes the phenomena involved with bare suggestion of the elements which enter into it. As a further illustration, revolving field alternators are treated entirely from the catalogue standpoint; the type is not differentiated, nor are its characteristics discussed or stated with the exception of one simple diagram.

Another fault in the book is apparent in its mention of the Scott phase-changing transformer. This is well described, but no reference is given in the recital. This bare mention would gain decidedly for the student, if a reference had been made to the clever paper of the inventor, in which the device was originally described. The present author, in common with many others, does not seem to realize that the mere statement of such facts is inadequate. A text-book of this character should be a suggestive guide to the literature of its subject matter so that it may enable the student to use his knowledge with a precision that can never be gained from a small book on a large subject. Insufficiency of treatment may also be instanced in the section describing the constant-current transformer; and again, though of a different nature, in the topic dealing with the synchronous motor.

The short chapter on rotary converters and the concluding chapters on power transmission, and testing, though lacking and unsatisfactory in many respects, yet gives an excellent discussion of many practical matters.

The diagrams are numerous and clearly drawn, and the book as a whole is well illustrated. The publishers, rather than the author, must be taken to task for the excessive size of many of the catalogue illustrations, which coarsely detract from the otherwise neat appearance of the text, and which are as blurred and blotched as is usual with the second derivative of a half-tone print. There are but few lapses into bad taste in evidence, but the most flagrant is that of Fig. 63*a*, where a rakish appearing individual serves to impress the size of a particular dynamo.

Les Theories Electriques de J. Clerk Maxwell. By M. P. Duhem. Paris: A. Hermann. 228 pages. Price, 8 francs.

This critical study of Maxwell's contributions to the theory of electricity and magnetism by one who has done so much in other branches of theoretical physics, particularly in thermodynamics, is a very welcome addition to scientific literature. Especially should it be welcome to French students who have shown such great reluctance during the thirty years past to accept the theories of Maxwell.

The author gives a very comprehensive survey of the development of electrical theory, including the theories that preceded Maxwell, and his study of Maxwell includes all of Maxwell's earlier memoirs as well as Maxwell's great treatise, which appeared in 1873.

In writing of the theories of Maxwell in 1890, the eminent French scientist, Poincaré, said: "When a French reader opens Maxwell's treatise a sentiment of dislike, and even of defiance arises, which is dissipated only after prolonged study and at the cost of great effort. Some eminent minds indeed always retain this initial sentiment."

"Why is it," asks Poincaré, "that the ideas of Maxwell have been with so much difficulty acclimated in France?" It is without doubt due to the influence of the writings of the great French scientists of the early part of the century. "All our masters," says Poincaré, "from Laplace to Cauchy, have proceeded in the same manner. Starting from hypotheses neatly stated, they have derived all the consequences with mathematical rigor, afterwards comparing them with experience. The French have seemed to wish to give to each of the branches of physics the same precision as is shown by the Mécanique Céleste."

The reluctance which the French have shown in their acceptance of Maxwell's theories throws much light upon the characteristic features of electromagnetic theory; a theory which is confronted with a vastly greater variety of phenomena to be correlated than is presented in any other single branch of physics. Laplace needed only to start with the fundamental notion of universal gravitation and the fundamental notion of inertia. Maxwell had to start with a great variety of fundamental notions. Laplace's "Mécanique Céleste" is solely an algebraic development entirely independent of conceptual helps. Maxwell's theory on the other hand is principally a conceptual development with detached algebraic helps. A student determined to find in Maxwell either a repetition of Laplace's method or nothing at all would certainly find nothing at all, and this is what the French found in Maxwell during a period of twenty years.

United States Automobile Patents. Supplement to Digest of United States Automobile Patents (1789-June, 1899). July, 1899, to January, 1902. Compiled by James T. Allen. Washington: American Patents Publishing Company. 748 pages. Price, $10.00.

This volume forms a supplement to the compilation by the same author of the automobile patents prior to July, 1899, and covers all patents granted since the earlier volume was printed up to January, 1902, since which latter date these patents have been digested in the *American Electric and Automobile Patents Monthly* (which publication also includes air and gas engines). The volume thus bridges the period covered by the earlier volume and that now being covered by the monthly publication. The book includes every patent relating directly or indirectly to the art issued within the dates noted in the title, every sheet and figure of the drawings, no matter how numerous, the claims in full, and a brief description when necessary to properly interpret the claims.

One of the most valuable features of the work, which is also a feature of the *Monthly*, is the reference index. This is not merely an index in the ordinary sense of the term, but in addition to the patent number, the patentee, the title of the invention and the plate and claim folios, it gives also a list of the references cited against each application while pending in the United States Patent Office, thus indicating the previous state of the art when the patent was granted.

The inventions are plainly classified in the text according to the different sub-classes. While in the Digest only ten sub-classes were established, yet in the shorter space of time covered by the Supplement the art has grown and expanded to such an extent that it was necessary to establish eleven new sub-classes, making twenty-one in all; one of these is entirely new, that of mufflers, or noise-quieting devices, which has been brought down from 1789 to January, 1902, as it did not appear in the Digest.

The work is printed by the photolithographic process, thus insuring absolute accuracy as to plates and text. The edition is limited to 500 copies.

Notes on Laying, Repairing, Operating, and Testing Submarine Cables. By Captain Edgar Russel, U. S. Signal Corps. Washington, 1902: War Department Document 172. 70 pages, 30 illustrations.

This is an elementary hand-book for the guidance of Signal Corps officers concerning the laying, operating and repairing of shallow-water submarine cables. A chapter is devoted to the construction, laying and repairing of cables, as effected in the Philippine Islands. Then follows a good chapter on the operation of the cables in the Signal Corps service. Next comes a chapter on normal cable testing. Then a chapter on locating faults in cables. The Fisher cable testing set used in the service receives a relatively long chapter, and the last chapter, by Col. Reber, is a very good one on factory testing of cables.

The book as a compendium of testing officers' notes is well condensed and designed. It would be benefited by the prefacement of a chapter index and by the addition of a subject index at the end. Doubtless these will be added in a subsequent addition.

Directory of Electrical Societies, Etc.

AMERICAN ELECTROCHEMICAL SOCIETY, Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa. Next meeting, New York, April 16, 17 and 18, 1903.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings: March 27th, "High-Tension Lines," Ralph D. Mershon; April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torcho and Peter Junkersfeld.

AMERICAN STREET RAILWAY ASSOCIATION, Secretary, T. C. Penington, 2020 State Street, Chicago. Next meeting, Saratoga Springs, N. Y., September 2, 3 and 4, 1903.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES, Secretary, W. H. Johnson, Philadelphia, Pa.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS, Secretary, P. W. Drew, Colby and Abbott Building, Milwaukee, Wis. Next meeting, New Orleans, La., May 13, 14 and 15, 1903.

CANADIAN ELECTRICAL ASSOCIATION, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

THE ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE, Secretary, Wm. J. Davis, Ithaca, N. Y.

ENGINE BUILDERS' ASSOCIATION, F. P. Ide, Springfield, Ill., Secretary.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS, Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., September, 1903.

IOWA TELEPHONE ASSOCIATION, Secretary, C. C. Deering, Des Moines, Iowa. Next meeting, Des Moines, March 10 and 11, 1903.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES, Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich., July 15, 1903.

NATIONAL ELECTRIC LIGHT ASSOCIATION, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 26, 27 and 28, 1903.

NEW YORK ELECTRICAL SOCIETY, Secretary, G. H. Guy, 114 Liberty Street, New York. Next meeting, American Institute, March 18. Lecture by Prof. R. H. Thurston on "The Steam Turbine to Date."

NORTHWESTERN ELECTRICAL ASSOCIATION, Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

A Modern Theatre Installation in New York City.

BY IRVING B. SMITH.

One of the latest and most interesting electrical theatre installations in New York City is that of Belasco's Theatre, at Forty-second Street and Seventh Avenue. The electrician of the theatre, Mr. Louis Hartman, is responsible for the entire electrical work, having planned it, laid it out and superintended its construction, including both auditorium and stage.

The theatre secures its current from the Edison 110-220-volt three-wire service. The auditorium is on a two-wire distribution, the stage on a three-wire distribution. From the main distribution center in

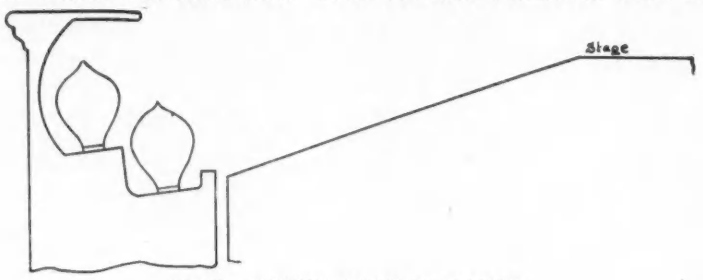


FIG. 1.—SECTION ACROSS FOOTLIGHTS.

the basement front run two sets of feeders, one to a distribution panel in the lobby, from which are controlled the lights on the stairways, smoking-rooms, reception rooms, lobby, box office, etc. The second set of feeders runs directly to the stage switchboard. All wires are run in iron conduit, there being no cleat or moulding work. No smaller wire than No. 6 B. & S. is used. All lights are in fixtures, drop cords not being permitted. All fuses are of the enclosed arc type and all distributing panels are in slate-lined oak cabinets.

The auditorium lights, excepting the chandelier and a few brackets, are concealed. The orchestra is situated in a pit below the audi-

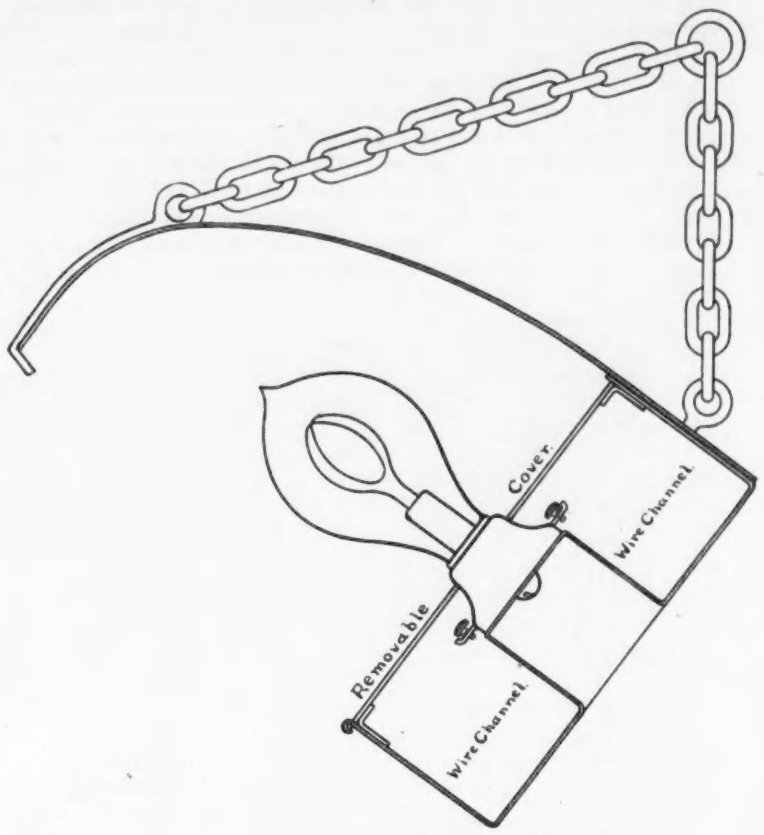


FIG. 2.—SECTION OF BORDER LIGHTS.

torium floor level. Each musician has a light enclosed in a rotating cylinder, permitting him to have either diffused white light or a blue light. The light is ample, and quite invisible from the auditorium.

Each dressing-room has a swiveled mirror, lighted by two side lights, there being also bracket lights. In the dressing-room used by Mrs. Leslie Carter is a pier glass, with three sets of lights in three colors, permitting the effect of colors upon the make-up to be determined. The dressing-rooms have also electrical curling irons, and electrical paint-warming plates. The red fire escape lights are, of course, connected back of the main distribution center and not controlled by the main switch. A telephone system of nine stations connects all parts of theatre with the box office, including the main office on the third floor.

The stage board, which is the important feature of the installation, is elevated about 9 ft. from the stage floor and located nearly against the proscenium wall; in fact, just far enough from the wall to permit of access behind. The elevation of the board prevents blocking the first entrance, and there seems to be no disadvantage in so placing it, providing, of course, that the board is so planned as to permit a single operator to easily control all circuits from one position. The gallery upon which the board is placed allows ample room for the operator, and the elevation often affords him an unobstructed view of the borders and foots, which could not always be obtained were the board on the stage floor. His duties occupy him constantly at the board and he is not troubled with the necessity of climbing up and down since everything is at hand at the board. One advantage gained is that the operator has his own place entirely to himself, and is not crowded by the many who are often awaiting their cue at the wings.

The stage board controls all auditorium circuits, including gallery and balcony lights; also all stage circuits in all colors, including dressing-rooms, entrances, etc. The stage has four borders, and there are also eight bunch pockets for bunches and strips, which pockets are, of course, let into the stage floor. There are also twenty-four stage outlets in the floor and on the bridges for arc lights, or as they are more familiarly known, electric calciums.

The arc outlets as well as the bunch pockets are independently controlled from switches on the stage board, and the bunch pocket circuits are also supplied with dimmers.

The footlight pan is so designed as to prevent the lights being observed even by those in the boxes, which are unusually near the stage. Fig. 1, a section across the footlights, shows the general arrangement. As will be noted the lights are arranged in two rows, the back row containing 50 red lights and 50 blue lights, and the front row containing 75 white lights, or more properly speaking, amber lights, since all white lights both in auditorium and on stage are dipped to a light amber to avoid the harshness of white lights.

All of the sockets are so arranged as to give the lamps a backward rake to throw the greater portion of the light in the desired direction. The back of the footlight pan and shield acts as a reflector. It may be noted also that the row of colored lights is somewhat higher than the white lights to avoid interference. A 9-in. shielding overhang effectually cuts off all light from the auditorium and boxes.

with eight lamps and a reflector mounted upon an adjustable stand.

On each side of the stage are located four bridges for electric calciums. These bridges are easily accessible from the stairways and don't require ladders to reach them. They are also well located to meet any requirement. The dressing-rooms have entrances off of landings on the stairways, two from each landing.

The controlling stage board is shown in Fig. 3. There are two white Italian marble panels, the left one containing 16 branch circuit switches for house branch circuits, all three-pole, back-connected. It carries also two operating levers for the two house dimmers, a main house switch shown in the extreme lower left-hand corner, and a main stage switch shown adjacent thereto. The fuse arrangement is particularly worthy of notice. There are used on all branch circuits "Noarc" enclosed plug fuses. These are let into the face of the board, screwing into a special back-connected receptacle. One pole of this receptacle forms a copper link directly connected to the clip side of the adjacent switch arm. The other pole forms

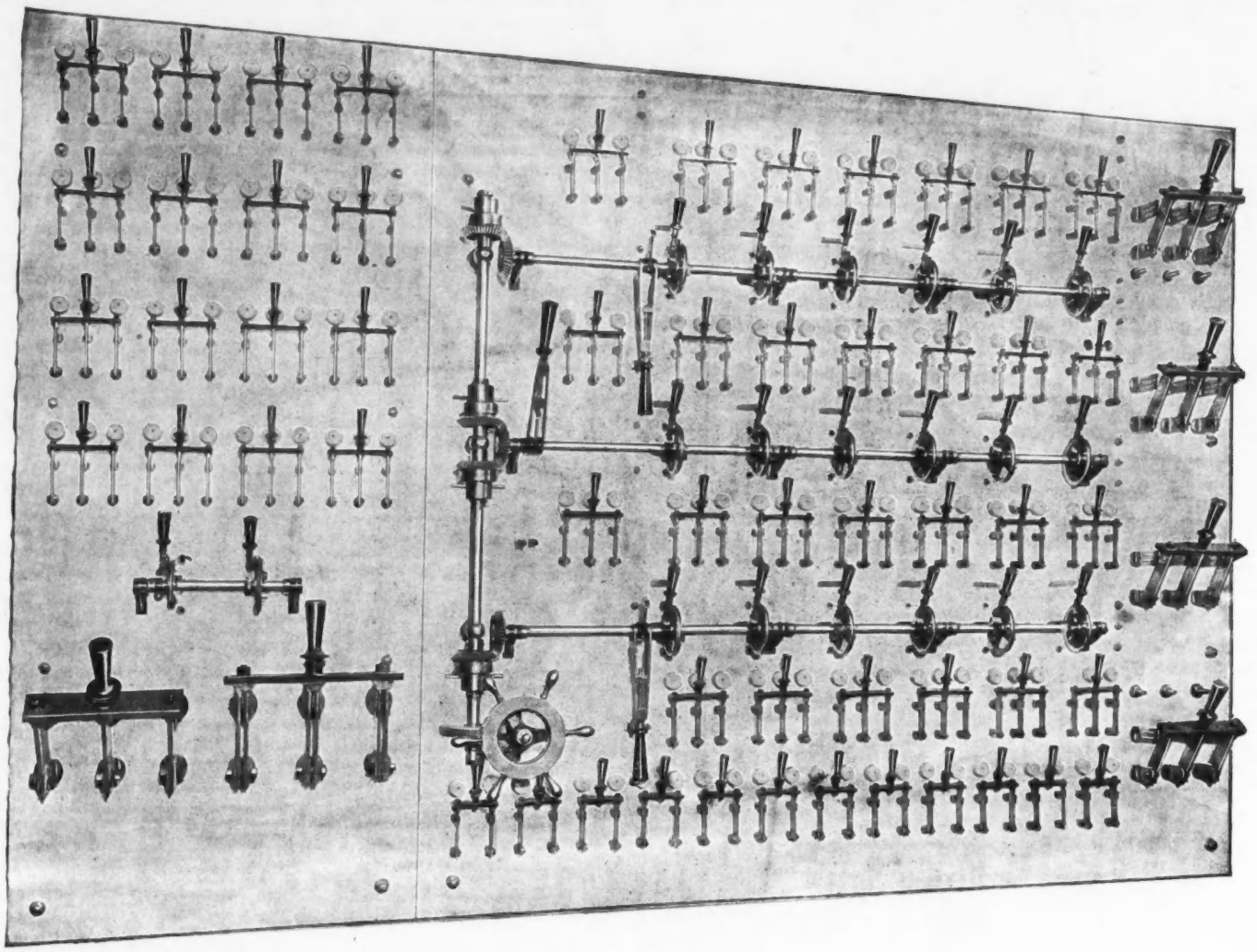


FIG. 3.—CONTROLLING STAGE BOARD.

The inclined apron in front has a drip to carry off any water that may run down from the stage when the floors are washed.

Fig. 2 shows a section of a border. A galvanized iron box is formed into a double channel having a flat space between, upon which the sockets are mounted. The two troughs so formed carry the wires. The three colors of lights are arranged in a single row in alternate colors, 50 white, 50 red and 50 green, each color three-wire. A removable metal cover protects the wires and sockets. On the top of the first border is a footway, permitting an operator to stand there to produce special mechanical or lighting effects. Double reflecting partitions between each pair of lamps aid in the proper distribution and prevent undesirable reflections between the different colors. The borders need not be tied off in position, as they are counterbalanced, and they are easily operated by one man.

Movable strips are provided, 24 in all, for side lighting. These are and switches. The strips are extremely substantial, and carry the lamps in a vertical position instead of presenting the lamps end on, as so often occurs. The bunch lights are of the usual construction.

a somewhat longer copper connecting bar making direct connection with a set of horizontal busses. A better idea of the arrangement of fuses can be gained from Fig. 4, which is a sectional view of switch and fuse receptacle. The extreme directness in connection from horizontal bus through fuse to switch is evident. It will be noted also that on this panel there are four sets of horizontal busses, all being fed from a single set of vertical busses from the main house switch, necessary enclosed arc fuses being interposed between the switch and the service. These fuses, not shown on the face of the board, are readily accessible at the end of the board. This panel measures approximately 33 in. in width and 75 in. in height, having a thickness of 1½ in. The second panel measures 81 in. in width and 75 in. in height, and contains all stage circuit switches and dimmer levers for these circuits.

There will be noted in the illustration three horizontal interlocking dimmer shafts, each with six individual dimmer levers and a master lever. Referring to these six levers, from left to right on the top shaft, which is for controlling white lights, they are marked as

follows: Bunch No. 1, foots white, border No. 1, border No. 2, border No. 3, border No. 4. Referring to the second or middle horizontal interlocking shaft the six dimmer levers control the following dimmers: Bunch No. 1, foots red, border No. 1, border No. 2, border No. 3, border No. 4. Lastly the bottom shaft controls the following dimmers: Bunch No. 3, foots blue, border No. 1, border No. 2, border No. 3, border No. 4. Fig. 5 shows the dimmer mechanism more in detail with three positions of a single dimmer lever, which may be briefly described as follows: On the back of the board is located a dimmer plate. On the face of the board, the operating dimmer lever, the interlocking mechanism, the master lever and the interlocking shaft. On the interlocking shaft is a loose sheave connected by means of a very flexible steel cable to a smaller sheave rigidly attached to the shaft of the dimmer plate. This latter shaft also carries the dimmer switch. The lever and handle are attached to the loose sheave for operation of this dimmer switch independently of other dimmers. A slotted cam permanently attached to the interlocking shaft near each loose sheave engages with a spring plug on the corresponding dimmer lever (providing the lever handle is so turned as to permit of such engagement). By giving the handle a

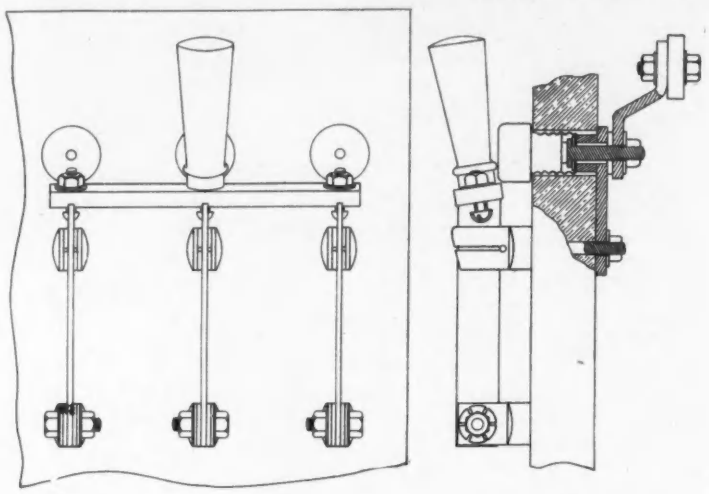


FIG. 4.—SECTIONAL VIEW OF SWITCH AND FUSE RECEPTACLE.

quarter turn the spring plug is disengaged from the cam and the lever is free to move, thereby allowing the operator to raise or lower the lights controlled by that particular dimmer, irrespective of the others. In this way any circuit may be controlled independently of all other circuits.

If, however, it is desired to operate several of the dimmers on one interlocking shaft at one time, the corresponding lever handles are not turned. For example, this board has on the white light shaft dimmer levers for bunch lights, foots, borders, Nos. 1, 2, 3 and 4. It may be necessary to lower only the foots, the first and third

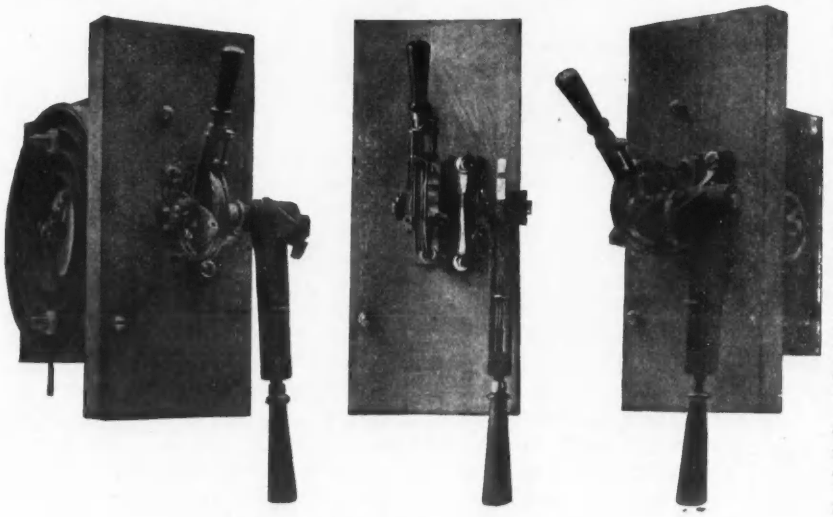


FIG. 5.—DIMMER PLATES.

borders. To do this, the operator leaves the handles of these dimmers so turned as to permit of engagement with their respective cams. This interlocking shaft operates by means of its master lever, and the desired dimmers will be picked up by their cams in whatever positions they may have been left, and the corresponding lights raised or lowered simultaneously.

In this installation the dimmer plates were not located directly back of the board as shown in Fig. 5, but some distance above the board and against the proscenium wall (Fig. 6). The steel operating cables passing over idlers go direct to these dimmer plates. In many instances it is found advisable to mount the bank of dimmers beneath the stage floors, in the basement. In this instance, however, there was ample room against the proscenium wall and the presence of the numerous arc light bridges and stairways made them readily accessible. This bank of dimmer plates including in all twenty dimmers, is mounted on slate, the opposite polarities being carefully insulated. This arrangement insures against any general disablement of the dimmers due to accident.

Referring to Fig. 3, there will be seen a vertical gang shaft provided with mitre gears and friction clutches, also a worm gear operated by a pilot wheel for slow motion. As will be noted, the middle horizontal interlocking shaft for red lights has a double set of friction clutches and mitre gears, enabling this shaft to be run in opposition to either the white or the blue lights or enabling it to be run in the same direction as either of these. It will be also noted that the mitre gears on the white or top shaft are in a reversed position with those on the blue or bottom shaft, thereby permitting these two shafts to be run in opposite directions. This combination of gears secures all desired combination of colors, and the use of friction clutches instead of positive clutches enables any one or more of these horizontal shafts to be thrown into or out of operation at any time, and without stopping the motion of the vertical gang shaft.

Adjacent to each dimmer lever there is a three-pole back-connected knife switch, fused with enclosed arc plug fuses directly above the switch. This fuse arrangement is the same as referred to on the house panel for branch circuits. All branch circuit switches including the 39 branch stage switches are of 75 amp capacity, not because of any electrical requirement, but simply to gain the necessary mechanical strength. These switches are thrown in and out suddenly several times each night, and often handled without much regard to their safety. It has been learned by experience that a small switch is useless in such cases. All switches were made by the Frank Adam Electric Co., St. Louis, Mo. In each instance the switch that is adjacent to a dimmer lever controls the same circuit. We find, therefore, all together, the fuses, the dimmer and switch for any one circuit. Comparing this with the usual method of having a fuse panel for all branch fuses, it would seem that in case of trouble this arrangement is far superior. You don't have to hunt around amongst a lot of fuses wondering which one belongs to the circuit you are after, nor do you in your haste put your screw driver across another one and blow that, too. In case of trouble on any circuit, the fuse can be quickly removed and examined or a new one inserted. If there is any question as to whether the line is alive, the operator can place a finger across the fuse receptable terminals and find out. The master lever on each shaft referred to above, when not in use, may be thrown into a clip on the board and kept entirely out of the way. They interlock on the interlocking shafts in the same manner as do the individual dimmer levers.

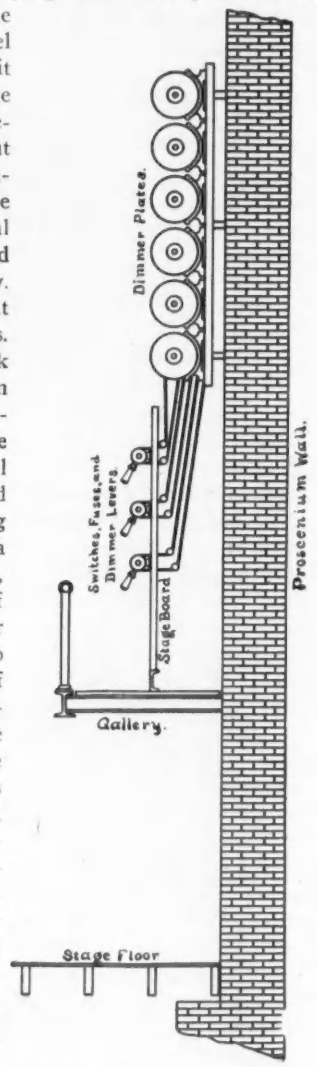


FIG. 6.—ARRANGEMENT OF DIMMER PLATES.

As indicated on the house panel, these fuse receptacles are connected on the one side to the branch circuit switch clips and on

the other side to horizontal bus-bars. There are, therefore, five sets of horizontal bus-bars feeding from a set of vertical bus-bars through the breakdown switches shown on the extreme right of the board. The function of these switches is to permit of a dark change; that is, a sudden change, from one set of one color of lights to perhaps a different set of a different color of lights. The top breakdown switch feeds all white light circuits on the stage through the above-mentioned horizontal busses. The second breakdown switch feeds the red lights and in the same manner the third feeds the blue lights. The bottom breakdown switch feeds two sets of circuits, one the branches, dressing-rooms, fly galleries, etc., from the lower row of three-pole switches, the other the arc outlets on the stage from the 12 two-pole arc switches. The necessary enclosed arc fuses are interposed between the main feeders and the breakdown switches. These are readily accessible from the right end of the board. The entire board is enclosed in a case with sliding front.

This is the first time in the history of stage lighting, to the writer's knowledge, that a theatre board has been designed and planned with the idea of simplifying the wiring and circuits to the utmost. The usual method is to place below the stage panel a separate fuse panel, and wire everything from the service to the fuses, from the fuses to the switches, and from the switches to the circuits. This invariably produces a confusion of wires and circuits in the back that is simply appalling if any trouble necessitates tracing out a circuit.

Stepping behind this board, however, it will be noted that there is absolutely no wiring from the service to the hinge side of the branch circuit switches, and from this side a wire leads off in a direct manner and without confusion to the proper circuits. These wires are run in circular loom conduit to the point overhead where they reach the iron conduit. All bus-bar work has ample capacity for an enormous overload. All switches are equally capable of taking care of a heavy overload. The entire stage board was designed

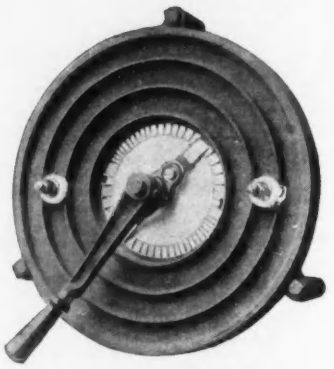


FIG. 7.—SINGLE DIMMER PLATE.

and manufactured by the Wirt Electric Company, of New York City.

A word might be interesting as to the type of dimmer used in this installation. Referring to Fig. 7 is shown a single dimmer plate. It is supplied, however, with a sheave instead of the lever indicated, and requires less than a half revolution on the shaft in order to cut in or out the entire number of 50 steps. One interesting feature in the construction of this dimmer is that not only are the resistances in the individual steps graded in a manner to secure imperceptible jumps in the lights, but the contact points from which the switch carries its current are also graded to secure a uniform rating in ampere capacity per square inch of brush contact. The brush is of the laminated type, insuring a good contact with a light pressure. It was endeavored to give every dimmer ample capacity, and avoid the trouble usually arising from the almost inevitable overload that a dimmer gets some day when it is required to carry an unusual load to produce some novel lighting effect. The many other electrical features are perhaps not of general interest or at least offer nothing special or novel in the way of electrical work. It might be interesting to state that the entire installation was so carefully planned and executed that neither the fire underwriters, the city department nor the New York Edison Company required a single change.

Switchboard Circuit Breakers.

The General Incandescent Arc Light Company, having occasion to use a great number of circuit-breakers on its various installations, has made a thorough study of the principles of circuit-breaking. For example, the matter of using laminated contacts for carrying the current, a very small portion of which passes around the shunt to prevent the arcing at the laminations when the circuit was open, seems a simple thing to accomplish, and yet up to recently there has been more or less arcing at laminations. As the result of experiments, it was found that the trouble did not lie in the laminated contacts themselves, but existed in the method of shunting the current around them when the circuit was opened. It was discovered that to do this effectively, it is necessary to have a shunt of very low resistance, and this implied a metallic shunt supplemented by a carbon shunt, the circuit being successively opened, first, by the laminations and then by the metallic shunt, and then finally by the carbon shunt.

One of the advantages of laminated contacts over those of the knife blade principle is that every portion of the surface of contact is made available for carrying current, whereas in knife blade contacts the surface of contact is very much less than the total surface available. This defect in the knife blade contacts is simply

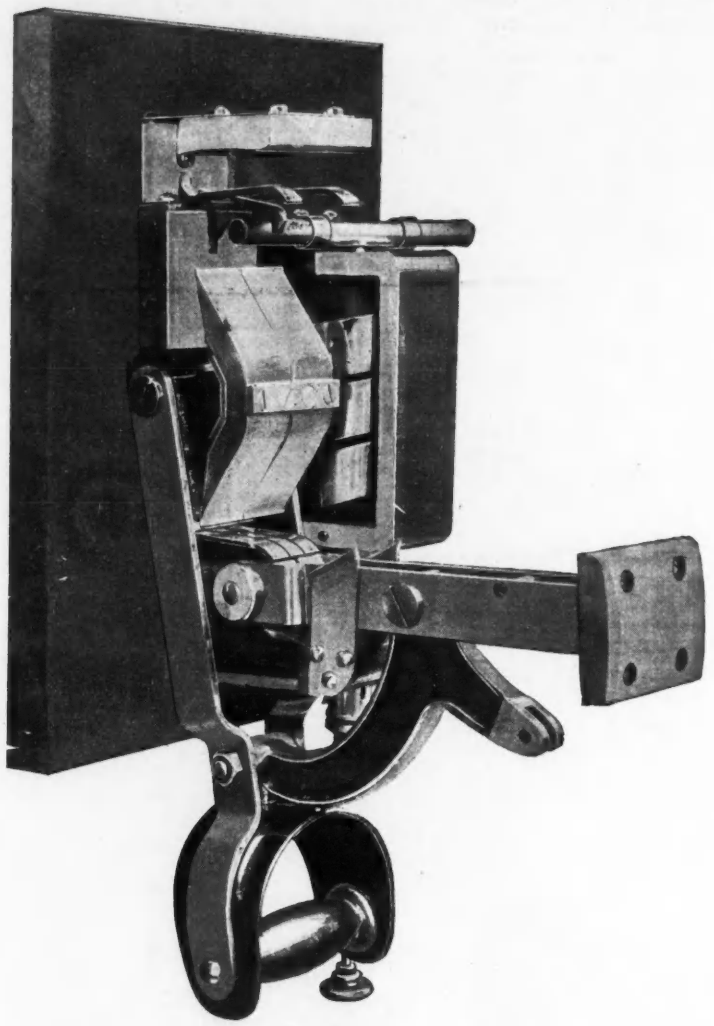


FIG. 1.—SINGLE-POLE SWITCH.

due to the fact that two plane surfaces cannot touch each other at all points, unless they are ground absolutely true to a plane surface, which is impracticable, both commercially and owing to the flexibility of the clips and the heating of the parts tending to destroy perfection of contact.

Another advantage of laminated contacts is that they always exert an effort to release themselves and thereby open the circuit, whereas the knife blade contacts tend to hold themselvs shut, often requiring a very strong initial hammer blow or effort to overcome what might be called the "friction of rest." The laminated form of contact on the other hand requires no effort of any kind, much less a hammer blow to start it to open the circuit. The General Incandescent Company has, therefore, adopted the laminated form of contact exclusively in all of its circuit-breakers of whatever sizes, ranging from 25 amp up to 12,000 amp. Fig. 1 shows a 2,000-amp, single-pole switch and Fig. 2 an 800-amp, double-pole. The General Incandescent circuit-breaker has its laminations mounted entirely inde-

pendent of the rest of the apparatus, so as not to be a drag on the moving parts, the laminations being supported on a bearing which is equipped with a spring assisting to throw the laminations open.

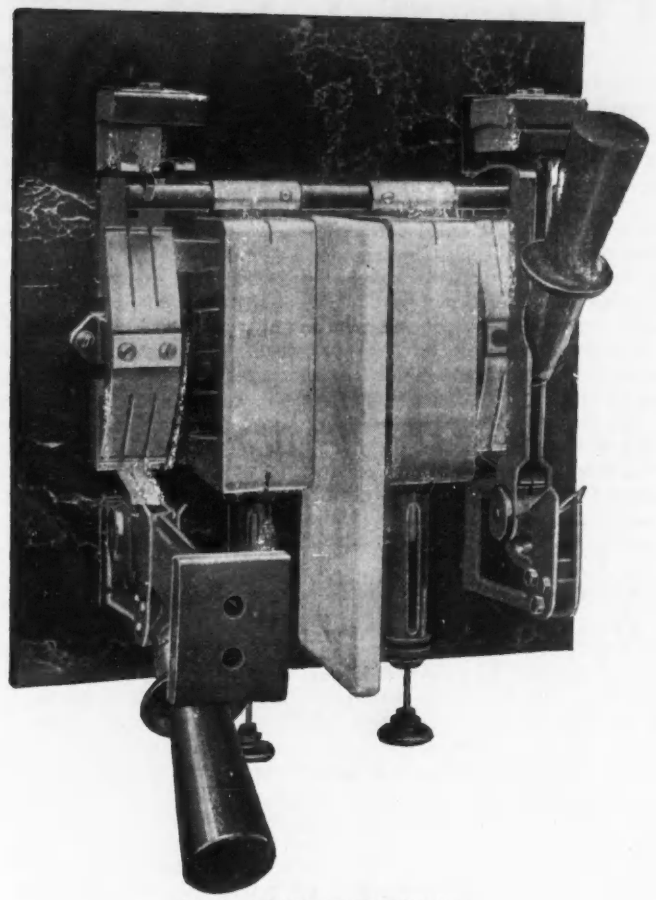
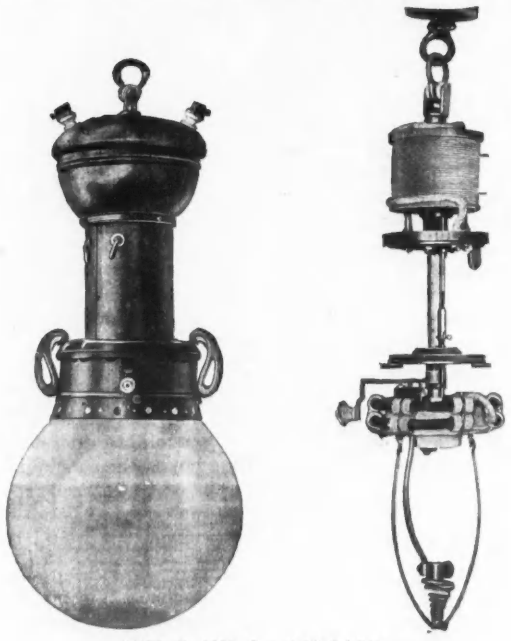


FIG. 2.—DOUBLE-POLE SWITCH.

The device is held closed by means of a latch, which is practically frictionless. When the circuit-breaker operates, the latch is released with a minimum pressure.

Interchangeable Arc Lamp.

The Osborn-Morgan Company, Cleveland, Ohio, will make a feature of a constant-potential interchangeable arc lamp. The change from direct to alternating-current work can be effected without any changing of parts, a feature which will readily be appreciated by central station managers, since it necessitates the use of but one style of lamp for all circuits.



FIGS. 1 AND 2.—ARC LAMP.

The lamp is of the enclosed type and the case, which is thoroughly weather proof, is made of sheet copper of sufficient thickness to insure stability and strength, so that the lamp may be used for outside as well as for inside work. The body of the case is composed of two doors, which may be thrown open by turning a latch, thereby exposing to view the entire working mechanism and making accessible all parts of the lamp. The clutch is of a simple ring type working directly upon the carbon. The portion in direct contact is of special insulated material insuring a steady clutch hold and freedom from burning out. Flexible cable contact is in use, thereby eliminating sliding contacts.

The actuating mechanism is a laminated horseshoe magnet in the head of the lamp, at a safe distance from the heat of the arc, which performs the functions of the customary reaction or choke coil of the alternating lamp and the solenoid in the direct-current lamps. It is claimed that it works equally well under any variation of voltage from 16,000 to 6,000 alternations per minute. Between the poles of the choke coil is the dash-pot and directly below this a laminated armature attached to the dash-pot plungers. The connection from armature to clutch contains a flexible member in the form of an asbestos tube, which prevents the vibrations of the alternating current from reaching the clutch and thereby jarring the carbon loose. A double-throw switch situated on the porcelain base changes the lamp from alternating to direct, or cuts the current off entirely. The resistance wire is coiled around the porcelain base of the lamp, in the path of a current of air, as shown in Fig. 2, thus insuring good ventilation. It is removable without disturbing other portions of the lamp. The lamp is claimed to be simple, efficient and economical in operation and noiseless on either class of circuit.

Watson Ball-Bearing Motors.

The Mechanical Appliance Company, of Milwaukee, has recently brought out a line of back-geared, vertical, ball-bearing motors in sizes ranging from ⅛ to 3 hp. The most prominent feature of these motors is the adoption of ball bearings, which not only decrease friction and increase efficiency and durability, but eliminate the objections heretofore held against ordinary vertical motors on the score of the impracticability of oil lubrication, there being no way to prevent the oil used for lubricating the top bearing from leaking onto the commutator and armature, thereby ruining the insulation. In these new motors the field frames are made of a special cast dynamo steel and are provided with a solid cast pole shoe. Each piece is machined at one operation to insure accuracy and interchangeability. The armature is of the form-coil ventilated type, thereby reducing the liability of heating to a minimum. Fig. 1 shows the standard back-geared motor, which is built on five frames, giving 20 different horse-powers at different speeds on all three voltages, namely, 110, 220 and 500. Speed reductions are obtained from five to one. Fig. 2 shows the vertical motor, which is built on four different frames of various speeds and for voltages from 110 to 500.

FIGS. 1 AND 2.—BALL-BEARING MOTORS.

NEWS OF THE WEEK.

THE WEEK IN WALL STREET.—Money hardened materially during the week, closing at 5 a 5¼ per cent. for 60 to 90 days, and 5¼ to 5½ per cent. for four, five and six months. In the stock market there was some activity, but the course of prices was generally toward a lower level, due to the disappointment over the failure of the Aldrich bill and the advance in the rates of money. The traction stocks showed some independent strength, as a result of the increased dividend declared by the Manhattan directors, the increase being to 1¾ per cent., which, together with an extra dividend of 1 per cent., places the stock upon a 7 per cent. basis. At the same time, Manhattan, although vigorously supported, shared in the general depression, and while inclined to improve sold off with the rest of the market. The announcement of the United States Steel bond issue fell rather flat, and the bonds which the preferred stockholders are invited to subscribe for at par sold at below 90 in the outside market. Metropolitan Street Railway showed some strength, and an effort to advance Brooklyn Rapid Transit, based on a report of an increase in its earnings, found little support. On Saturday prices in the general market broke heavily upon the publication of the bank statement, which was generally interpreted as a very weak showing. The entire list became depressed on average declines of from 1½ to 3 points. In the tractions Brooklyn Rapid Transit closed at 65½, being ¼ higher than the lowest price of the week, and representing a net decline of 1⅞ point. Metropolitan Street Railway closed at 135 after having reached 134⅜, the lowest, and 137 the highest, being a loss of 1¼ point. General Electric lost 4½ points net, closing at 190½, the range of prices being 190, the lowest, and 197½, the highest. Western Union fell off 1 point, closing at the lowest figure—38½. American Telegraph & Telephone closed at 168¼, being a loss of ¼ point. In Boston this stock showed a decline of 3 points for the week. Following are the closing quotations of March 10:

NEW YORK.

	Mar. 3.	Mar. 10		Mar. 3.	Mar. 10
American Tel. & Cable	83	80	General Electric	193⅛	190¼
American Tel. & Tel.	166	163	Hudson River Tel.	...	...
American Dist. Tel.	37	37	Metropolitan St. Ry.	135½	132⅜
Brooklyn Rapid Transit	66⅝	63⅞	N. E. Elec. Veh. Trns.	⅛	..
Commercial Cable	..	..	N. Y. & N. J. Tel.	166	..
Electric Boat	20	21	N. Y. E. V. T. Co.	9½	9
Electric Boat pfd.	35	30	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	2⅞	2⅝	Western Union Tel.	89	88¼
Electric Vehicle	3¾	8	Westinghouse com.	200	195
Electric Vehicle pfd.	11	13¼	Westinghouse pfd.	225*	200

BOSTON.

	Mar. 3.	Mar. 10		Mar. 3.	Mar. 10
American Tel. & Tel	167	163¾	Western Tel. & Tel. pfd.	99½	99
Cumberland Telephone	..	..	Mexican Telephone	2⅛	2⅛
Edison Elec. Illum.	295	..	New England Telephone	137	138
General Electric	194	192½	Westinghouse	102	100
Western Tel. & Tel	23	23	Westinghouse pfd.	102	102

PHILADELPHIA.

	Mar. 3.	Mar. 10		Mar. 3.	Mar. 10
American Railways	50¾	50	Phila. Traction	99⅛	97
Elec. Storage Battery	..	..	Phila. Electric	7⅛	6⅞
Elec. Storage Battery pfd.	81*	..	Pa. Electric Vehicle	..	..
Elec. Co. of America	9⅛	8⅞	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	Mar. 3.	Mar. 10		Mar. 3.	Mar. 10
Central Union Tel.	..	..	National Carbon pfd.	96	96
Chicago Edison	159	159	Northwest Elev. com.	29	..
Chicago City Ry.	217	210†	Union Traction	9⅛	9⅛
Chicago Tel. Co	155	..	Union Traction pfd.	42½	42
National Carbon	24	24			

*Asked. †Ex Dividend.

CONSOLIDATION IN NEW JERSEY.—A certificate consolidating eight South Jersey gas companies, under the name of the South Jersey Gas, Electric & Traction Company, has been filed with the secretary of state. The consolidated company has an authorized capital stock of $6,000.000 and by the terms of the merger is to issue at once $9,000,000 of bonds for the retirement of stock and bonds of the merged companies. Most of the concerns forming the consolidated company are gas companies, but the Stockton Electric Light & Power Company is included in the deal. The officers and directors of the new company are: President, Anthony R. Kuser, of Trenton; vice-president, William J. Bradley, of Camden; secretary, Forrest F. Dryden, of Newark; treasurer, Charles G. Cook, of Trenton. Directors—Attorney-General Thomas N. McCarter and Uzal H. McCarter, of Newark; Barker Gummere, Jr., Henry C. Moore, Richard Stockton, Jonathan H. Blackwell, ex-Judge Robert S. Woodruff and State Treasurer Frank O. Briggs, of Trenton; John J. Burleigh and Charles Watson, of Camden; John L. Kuser, of Bordentown; William J. Thompson, of Gloucester; Herbert W. Johnson, of Merchantville; Frank Bergen, of Elizabeth; Thomas C. Barr, of Orange; Stephen Peabody, of New York, and Robert C. Pruyn, of Albany.

DIVIDENDS.—Manhattan Elevated directors have declared a quarterly dividend of 1¾ per cent. and an extra dividend of 1 per cent. The last dividend declared was 1½ per cent. The Manhattan dividend of 1¾ per cent. covers the quarter ending March 31 and the extra dividend of 1 per cent. will be paid out of surplus earnings from nine months ending March 31. Both dividends are payable April 1st. The extra dividend on Manhattan will be paid out of the earnings of the past nine months. The dividends of Manhattan for the past nine months have been as follows: September, 1 per cent.; December, 1½ per cent.; March, 1¾ per cent., and 1 per cent. extra, making a total of 5¼ per cent. It is probably the intention of the directors to declare 1¾ per cent. in June, making the total for the year 7 per cent., which is the dividend guaranteed under the sale to the Interborough Company. At a meeting of the directors of the Commercial Cable Company the old officers were re-elected and a quarterly dividend of 2 per cent., an increase of ¼ of 1 per cent., was declared, placing the stock on an 8 per cent. annual basis. The regular quarterly dividend of 1½ per cent. on West Chicago Street Railway guaranteed by Union Traction, will be paid April 15.

INTERSTATE RAILWAYS COMPANY.—The recent elected board of directors of the Interstate Railways Company have organized by the appointment of John A. Rigg president in the place of Frank O. Briggs, Joseph L. Caven vice-president and Remi Remont secretary and treasurer. President Rigg says: "The taking over of the United Power & Transportation Company by the Interstate Railways Company was practically a reorganization enabling us to bring in new blood and fresh capital. The Interstate Company will now proceed to build one after another, the 22 ripper electric railway charters which the United Power & Transportation Company secured under the act of 1901. Work is being done on two of them now. These 22 charters cover together a very considerable stretch of territory in New Jersey and Pennsylvania, all tributary to Philadelphia." The United Power & Transportation Company, which has recently been taken over by the Interstate Railways Company, shows the year ending December 31, 1902, credits of $899,643 and debits of $633,658, showing a balance to the credit of income account of $265,984.

NORTH AMERICAN STOCK.—Circulars have been issued to the stockholders of the North American Company, notifying them of a proposition to increase the capital stock of their company from $12,000,000 to $17,000,000. The purpose of the stock increase, according to the words of the circular, is "to pay for the stock of the Laclede Gas Light Company, of St. Louis, which the North American Company has purchased, and to enable the company to extend and increase its investment and interest in gas and electric lighting business in St. Louis and elsewhere." The project to increase the capital by $5,000,000 has received the approval and recommendation of the Board of Directors of the North American Company. The new stock will be offered at par to the stockholders as soon as it is authorized.

KINGS COUNTY ELECTRIC.—It is believed that a consolidation of the Brooklyn Union Gas and the Consolidated Company is bound to come. The first step is to get the gas and electric companies of Brooklyn under one control and from indications an effort is being made at the present time to accomplish this end. It is thought that within a comparatively short time, the Kings County Electric Light, Heat & Power Company will pass under the control of Brooklyn Union Gas and that there will be some developments in this direction at the special meeting of the Kings County Electric stockholders' meeting later in the month.

LOUISVILLE LIGHTING INTERESTS.—As forecasted in this department in our issue of February 21, the directors of the Citizens' Lighting Company, of Louisville, and those of the Louisville Electric Light Company, have resolved to consolidate these two corporations. The new company will be known as the Louisville Lighting Company, and will have a capital stock of $3,000,000, and $4,000,000 in bonds. Stock to the amount of $2,800,000 and bonds in the sum of $2,500,000 will be issued when the company is organized.

SYRACUSE LIGHTING.—Application has been made to the New York Stock Exchange to list Syracuse Lighting $2,000,000 1st mortgage 5 per cent. bonds of 1915; $1,000,000 5 per cent. non-cumulative preferred stock; $3,000,000 common stock.

ELECTRIC STORAGE BATTERY STOCK.—Application has been made to the New York Stock Exchange by the Electric Storage Battery Company to list $4,500,000 preferred stock and $11,749,400 of common stock.

LIGHTING INTERESTS ON THE PACIFIC COAST.—It is understood that Stone & Webster, of Boston, who own or control nearly all of the electric lighting interests of the Puget Sound cities, are in the field for the control of the San Francisco lighting situation. A bond issue and perhaps a pooling arrangement are contemplated. Kidder, Peabody & Co., of Boston, are also interested in the consolidation, and the Seligmans, of New York, are expected, it is said, to finance the deal. It is supposed that the California Gas & Electric Corporation, which is the latest merger company of the capitalists composing the Bay Counties Power Company, will work in harmony with the syndicate in the consolidation. They own a dozen or more electric and gas plants in various parts of California. The Standard Electric Company, which has the long-distance water power transmission line furnishing power to San Francisco, will probably be taken over. The Spreckels plants cost about $5,000,000, and it is thought, will be taken in at an advance on this figure. The San Francisco Gas & Electric Company's plants were valued last year at about $11,000,000 by its officials and at $14,000,000 this year, though local engineers say they are not now worth more than $6,500,000 owing to depreciation with age, etc. While certain capitalists seem disposed to ignore the Mutual Electric Light Company in the consolidation, their competition would be a serious matter if their plant were not absorbed. It represents an investment of $600,000 in a paying plant and $400,000 in contracts for a new plant, which is to be installed this year. D. O. Mills and P. B. Cornwall, who are the principal owners, have their own coal mines, although they are now burning crude oil; and they are supposed to be ready for a fight if necessary. The combined earning capacity of the San Francisco lighting plants under favorable conditions is estimated at $30,000,000 per year, and about $5,000,000 should be realized in profits. At present scarcely any profits are being realized over the cost of repairs and extensions needed to keep pace with the growth of business induced by competitive rates. It costs about 3 cents per kw-hour to produce electric current. The legal maximum price is 5 cents.

Commercial Intelligence.

THE WEEK IN TRADE.—Reports received from Eastern and Western trade centers indicate that business is ahead of last year's and still expanding, and this satisfactory condition of things is confirmed by the largest February bank clearings on record, and the enormous gross railway earnings returns. Southern trade and crop preparations are somewhat retarded by heavy rains and rising rivers, but in spite of this influence receipts of cotton are heavier than a year ago. Special activity is noted by jobbers in all lines of wearing apparel. Active preparation for a heavy season's building is indicated by a large demand for material. There is also a stronger tone in iron and steel, finished products being in increased demand. A large business has been done in rails, structural plates, sheets, wire and tin plates. Structural material is very active, and the announcements of proposed large improvements to mills in the Pittsburg district create a very favorable feeling in that section. Foreign iron and steel are notably firm in price. Copper has made further advances in price, but consumers have stood aside without buying. Some little surprise is expressed at the duration of the present "boom" in prices. The closing quotations are: Lake and electrolytic, nominally 13½ a 13¾c., casting stock, 13.30 a 13.60c., and Standard 13c. Exports of copper during February were very small, and during the first two months of the year the decrease in the exports amounted to 10,312 tons, as compared with those of the corresponding period of last year. The number of business failures during the week ending March 5, according to *Bradstreet's*, numbered 171, against 185 the week previous, and 204 the corresponding week last year.

WIRELESS OUTFIT FOR ERIN.—Sir Thomas Lipton's steam yacht *Erin* will be equipped with a wireless telegraphy outfit for use during the international races this summer. The De Forest Wireless Telegraph Company wrote to Sir Thomas recently, suggesting that a wireless apparatus be placed on the yacht, so that, with the five stations of the company, including the one at 17 State Street, the *Erin* could remain in communication with shore during the whole race. Sir Thomas's cablegram, which was received last week at the offices of the company, was as follows: "Your letter 20th received. Will be pleased to arrange for De Forest wireless telegraphy on board *Erin*, as offered." In regard to this a cable dispatch from London of March 6 says: The Marconi Wireless Telegraph Company announces, apropos of the intention of Sir Thomas Lipton to allow the De Forest Wireless Telegraph Company to install its system on his steam yacht *Erin*, for use on the voyage across the Atlantic and during the races for the America's Cup, that it will sue the De Forest Company for infringements.

BRITISH EQUIPMENT FOR LORENZO MARQUEZ ROAD.—Everything, with the exception of a few odds and ends in connection with the equipment, etc., of the Lorenzo Marquez (Portuguese East Africa) electric traction system, will be purchased in England, considerably more favorable quotations and quicker deliveries having been offered on the other side than in the United States. The contract for the construction and equipment of the road was recently awarded to the British electrical engineering and contracting firm of Macartney, McElroy & Co., Ltd. The value of the contract is about $2,500,000. The initial length of the road will be 15 miles. No. 00 trolley wire will be used. The cars will be single-deck, somewhat similar to the summer ones which are operated on the Metropolitan Street Railway. Single trucks will be employed. The motors will be of double type, two of 25 hp or 30 hp each. The equipment of the power house will include two generators of 200 kw capacity each, for direct connection to high-speed engines.

GERMAN STRUCTURAL MATERIAL FOR THE UNITED STATES.—The General Supply & Construction Company, whose New York offices are in the Maritime Building, has recently placed several orders abroad—in Germany principally—for structural material for use in various buildings throughout the United States, European terms both as regards prices and deliveries being much better than those which at present exist on this side. About 600 tons of steel will be imported for use in the construction of the new Social Hall, Clinton Street, New York. The Norman Street School and the Lovejoy Wharf, now under construction in Boston, will also be built with German structural material. Six hundred tons will also be used for the extension of the St. Charles Hotel, New Orleans, La. European steel has also been ordered by the General Supply & Construction Company for utilization in two buildings under erection in Cuba.

WELLINGTON (NEW ZEALAND) TRACTION CONTRACT.—American manufacturers submitted figures, through the New York offices in the Havemeyer Building of the British electrical engineering and contracting firm of Macartney, McElroy & Co., Limited, London, for part of the equipment required to fill the contract valued at $650,000 secured by that firm for the Wellington (New Zealand) municipal electric traction system. Prices were obtained on this side for the initial car equipment which will consist of 12 double and a similar number of single cars to be furnished with single trucks, eight combination cars with double trucks, one track-cleaning and sweeping car and a freight truck. Quotations were also obtained in the United States for the overhead equipment. The power house equipment will be purchased in England. High-speed engines have been requisitioned for.

ANOTHER BIG BRITISH CONTRACT LOST TO AMERICANS.—Owing to more advantageous prices and better terms of delivery having been secured from British manufacturers, the important contract for the electrical equipment of what it is claimed will be the largest newspaper printing plant in the world will be placed on the other side. The contract refers to the new London plant of Edward Lloyds, Limited, which publishes the *London Daily Chronicle* and *Lloyd's Weekly*. George W. Mascord, the chief engineer of the concern, was in the United States for several months last year looking into the matter of equipment. The printing presses will, however, be of American manufacture, Robert Hoe & Co., 504 Grand Street, having secured the contract, which is valued at nearly three-quarters of a million dollars.

AUTOMATIC TELEPHONES FOR GERMANY.—The Automatic Electric Company, of Chicago, states that it has received an order for immediate delivery from the Imperial Telephone Exchange, which is managed by the Postal Department of the German Government, for 1,070 automatic telephones and switches to be used in extending the automatic telephone service in Berlin, the German capital. The exchange which is to be enlarged has been in operation since May 20, 1900. It was built by the American company and operated until July, 1901, under the auspices of German telephone engineers, at which time it was purchased by the government.

CHATTANOOGA LIGHTING IMPROVEMENTS.—The Chattanooga Light & Power Company is to put up a new power building to cost $17,000 and will install steam turbine capacity of 3,000 hp, with new boilers giving steam at 200 pounds pressure. A stack 200 ft. high will be erected, with an interior diameter of 10 ft. The various improvements are to cost $250,000. Mr. W. E. Boileau, of the General Electric Company, will be in charge of the installation of the electrical equipment, including a 30-panel switchboard.

THE NERNST LAMP COMPANY, of Pittsburg, having secured patents and selling rights in Canada, is now making arrangements for establishing a factory in the Dominion for the manufacture of its product. This move is not only necessary in order to conform with the Canadian laws of commerce, but is also advisable in order to meet the rapidly increasing demand for this lamp.

TELEPHONY IN PHILADELPHIA.—The Bell Telephone Company, of Philadelphia, celebrating its twenty-fifth anniversary, reports over 40,000 telephones connected in Philadelphia alone and 15,000 more in Camden. The increase in the past year was due to the new departure made by the company in installing residence telephones free of cost, and charging for each outgoing call simply. The basis on which the opposition Keystone Telephone Company entered the field was at rates one-half those of the Bell. It reports 8,700 telephones connected in Philadelphia and 1,100 in Camden, N. J. The comparative figures of capitalization, telephones connected, etc., show:

	Bell.	Keystone.
Capital stock, preferred	$12,000,000	$5,000,000
Capital stock, common	.....	5,000,000
	.....	10,000,000
Dividends (8%)	960,000	.....
Tels. connected, Philadelphia	40,000	8,700
Tels. connected, Camden	15,000	1,100

THE WARREN ELECTRIC MANUFACTURING COMPANY has for the past year been expending considerable sums in betterments to its general plant at Sandusky, Ohio. The capacity of its works has been doubled inside of twelve months and a fine new office building has been erected at the corner of Fulton and Market Streets, providing ample space for the various sales departments, engineering and drafting rooms and general business offices. During the past few days orders for machines have been booked by this company as follows: Milford, Mich.; Bremerton, Wash.; Laclede Gas Light Company, St. Louis, Mo. (2); Carthage, Tex.; Williamson, W. Va.; Union City, Ind. (2); Redfield, S. D.; Purcell, Ind. T.; Grand Rapids, Ohio; North Fork, W. Va.; Navarre, Ohio.; Delta, Colo.; Ritzville, Wash.; Somerset, Ky.; Dresden, Ohio; Sanford, N. C. (2); St. Clairsville, Ohio.

THE BISHOP & BABCOCK COMPANY, of Cleveland, is equipping its machine shop for electric driving. The group system has been adopted and short lengths of line shafting throughout the shops are driven by Westinghouse induction motors. Seven or eight of the latter, ranging in size from 10 hp to 40 hp, have been purchased and are now in operation, current being temporarily supplied from the plant of the Cleveland Twist Drill Company, which is also equipped with Westinghouse apparatus. The Bishop & Babcock Company, however, is installing a power plant of its own and has recently purchased a 175-kw, two-phase Westinghouse engine-type alternator, with switchboard complete. George S. Rider & Co. are the engineers for the plant.

IMPORT OF RAW MATERIAL.—The increase in the imports of raw materials of manufactures continues. According to the latest bulletin of the Bureau of Statistics, the value of these imports for the month of January was $42,328,478, which was about $5,000,000, or 14 per cent., more than for the same month of last year. Since the close of the fiscal year the increase as compared with the first seven months of the last fiscal year has been $40,000,000, or over 17 per cent. The total of these imports forms now nearly one-half, over 46 per cent., of all our imports. Up to 1899 the proportion had rarely been more than about one-third of all the imports. The increase since 1899 has been nearly 80 per cent. of the average for the previous ten years.

HUGE ELECTRIC CRANE CONTRACT.—The largest shipbuilding crane plant in the world is to be installed in the Harland & Wolff yards at Belfast, Ireland. The machinery will be operated electrically. The contract has been secured by the Brown Hoisting Machinery Company, Cleveland, Ohio, New York offices, Havemeyer Building. There will be three cantilever cranes having an average capacity of about 20 tons. Each crane will be mounted on a trestle 120 feet high and 600 feet in length. Each machine will operate over two shipways. The motors will be of General Electric and Westinghouse build. The value of the entire contract is about $300,000.

ANOTHER BUENOS AYRES TRACTION PROJECT.—Another electric traction system is to be built in Buenos Ayres, Argentine Republic, the Buenos Ayres Grand National Tramways Company, Limited, which operates the most extensive horse lines iu that part of the world having decided to adopt electricity as a motive power. The company, which has British capital, and London offices at 6 Eastcheap, E. C., operates 48 miles of road and controls the horse section of the Buenos Ayres New Tramways Company, Limited. In the first instance, 30 miles of the joint lines will be connected.

THE LAWRENCE-HALL ELECTRIC COMPANY.—Mr. F. D. Lawrence, formerly president of the Standard Electric Company, Cincinnati, one of the oldest established electrical supply houses in the West, and the firm of the Hall Electrical Supply Company, formerly known as Hubbard, Hall & Co., have incorporated a new company to be known as the Lawrence-Hall Electric Company. Mr. F. D. Lawrence is president and treasurer, Mr. William A. Hall is vice-president and general manager, and Mr. George H. Jones is secretary.

MEXICAN TRANSMISSION PLANT.—R. M. Burke, formerly United States consul in the city of Chihuahua, Mexico, who recently secured a franchise for the construction and operation of an electric power transmission plant in the State of Chihuahua, is about to award contracts in connection therewith. A dam is to be constructed across the Concho River at La Joya. The energy is to be transmitted to the city of Chihuahua, which has about 13,000 inhabitants, and to Parral, which has a population of about 8,000.

MANILA TROLLEYS.—A syndicate consisting of Westinghouse, Church, Kerr & Co., J. G. White Company, of New York, and Charles Swift, of Detroit, made the only bid for the electric street railway and light and power franchises of Manila last week. The syndicate offered 2½ per cent. of the gross receipts of both franchises for 50 years. The syndicate has already absorbed the horse railway. The German electric concern which was interested in securing the franchises withdrew at the last moment.

SERIES ALTERNATING FOR COLUMBUS, OHIO.—One of the most important contracts for series alternating equipment that has been awarded within the United States was recently let by the city of Columbus to the Western Electric Company, of Chicago. This equipment comprises 1,500 series alternating arc lamps complete, and is to be arranged in twenty 75-light circuits. The contract includes transformers, regulators and the entire switchboard for the new municipal plant.

MEXICAN TRACTION PROJECT.—The construction of an electric traction system between Oaxaca and Mitla, Mexico, is projected by Americans. The former place is located in the State of the same name. It has a population of about 30,000. Mitla is situated about 26 miles distant. It has extensive remains of ancient tombs and other edifices and is one of the show places in the Southern Republic. Colonel Hickenlooper, of Columbus, Ohio, is interested in the scheme.

THE ELECTRIC CARRIAGE CALL COMPANY, 1402 Broadway, New York City, has recently installed its apparatus at the Waldorf-Astoria Hotel. Two sets of apparatus are to be installed at the Hotel St. Regis. In Washington the apparatus has been constantly in use by the National Electric Supply Company at the White House, the Congressional Library, the new Willard Hotel and the Arlington Hotel.

MEXICAN LONG-DISTANCE TELEPHONE SYSTEM.—Mr. John Woessner, formerly United States vice-consul at Saltillo, Mexico, has been granted a concession for the construction of a long-distance telephone system throughout the Southern Republic. Work on the line between Monterey and Torreon, a distance of about 300 miles, is already in progress and is expected to be completed by May 1.

CAHALL BOILERS FOR NEW YORK CENTRAL SHOPS.—The Weehawken (N. J.) shops of the New York Central Railroad—contracts for the generators, etc., to be installed in which were noted in these columns last week—are to be equipped with four 500-hp Cahall boilers built by the Aultman & Taylor Machinery Company, of Mansfield, Ohio. The contract was secured by Thayer & Company.

WESTERN ELECTRIC CONTRACTS.—A contract aggregating over 600 kw in generators and over 1,000 hp in motors, was recently awarded to the Western Electric Company by Albert Schwill & Co., Chicago. A 300-kw, 150 r.p.m. generator was recently purchased by the Danville Street Railway & Light Company, Danville, Ill., from the Western Electric Company, of Chicago.

WESTINGHOUSE TURBINES FOR SOUTH AFRICA.—The Westinghouse shops at East Pittsburg have just shipped two steam turbo-generators of 1,000 kw capacity each to be installed in the power plant of the De Beers Consolidated Diamond Mines, South Africa, for lighting the mines and also for supplying current to light part of the town of Kimberley near by.

EQUIPMENT FOR DENVER.—The Denver Tramway & Power Company, of Denver, Colo., is at present placing contracts for equipment to be installed in a considerable extension to its plant. John A. Mead & Co., 11 Broadway, have taken the contract for the coal and ash-handling machinery, which will be capable of taking care of 45 tons per hour.

THE INTERNATIONAL HARVESTER COMPANY, of Chicago, Ill., having found the illumination afforded by the Nernst lamp so entirely satisfactory, has recently placed an order with the Nernst Lamp Company for 150 lamps in addition to the several hundred which are already installed at its plant.

AMERICAN CABLES FOR LONDON UNDERGROUND.—The National Conduit & Cable Company, Times Building, New York City, has secured the contract for the cables to be laid for the extension of the London Central Underground Railway.

General News.

THE TELEPHONE.

SAN FRANCISCO, CAL.—A. E. Smith, who has been in San Francisco for three months endeavoring to obtain a franchise for an independent telephone system, was recently given another hearing by the Public Utilities Committee of the Board of Supervisors, but no action was agreed upon. The cost of an adequate underground telephone system would be between three and four million dollars. Smith, who successfully promoted an independent telephone system in Los Angeles, has good financial backing. The applicants offered no special inducements to obtain the proposed franchise. They are willing to rest their case on the possibility that the city needs a better service than the Pacific State Telephone & Telegraph Company is now giving. There are many ten-party lines in use at present.

CANTON, GA.—J. W. Jarvis has about perfected details for installing a local telephone system in Canton to work in conjunction with the Southern Bell.

CHICAGO, ILL.—The Chicago Telephone Company reports a net gain of 1,180 telephones for February.

LAURA, ILL.—The Northern Millbrook Telephone Company has been incorporated, with a capital stock of $600, by I. M. Stowell, J. A. Shafter and E. I. Barrett.

TUSCOLA, ILL.—The Tuscola Telephone Company has been incorporated with a capital stock of $5,000. The incorporators are Wilbur F. Murdock, F. P. Dowter, G. L. Chapman.

CHICAGO, ILL.—The committee on telephone rates of the Chicago City Council has recommended a schedule based on measured service with a minimum charge. For a single party line the rates recommended run from $60 per year minimum for 600 calls, plus five cents per call for calls in excess of this amount, up to $118, minimum charge for 2100 calls, with three cents per call for all over that amount. For a two-party line the minimum rate for 600 calls is $44, and for a four-party line $28. For a ten-party line the rate recommended is $18, for 300 calls, and five cents per call for all calls above that amount. The adoption of measured service entirely instead of unlimited service is believed by the committee to be the best method of charging and one that will improve the efficiency of telephone service, by doing away with unnecessary use of the telephone.

ANDERSON, IND.—The Anderson & Fall Creek Telephone Company, of Anderson township, has been incorporated, with a capital stock of $4,000, by H. Wertz and others.

LIGONIER, IND.—The Columbia City Home Telephone Company will, during the present season, rebuild many of its lines and install a new switchboard at a cost of over $5,000.

LINTON, IND.—The Linton Home Telephone Company has been reorganized and the capital stock has been increased to $100,000. The company expects to extend its system and greatly improve its service.

DES MOINES, IA.—The Iowa Telephone Company has appropriated $200,000 for improvements and extensions to its system in this city. A new exchange building will be erected.

IOWA FALLS, IA.—At the annual meeting of the Central Telephone Companies of Iowa the following named officers were elected: President, J. R. Skein, of Laporte; vice-president, J. H. Funk, of Iowa Falls; secretary and treasurer and general manager, W. V. Shipley, of Iowa Falls.

HILLSBORO, KY.—The Hillsboro Telephone Company contemplates extending its lines to Sunset, and will probably build a line to Grange City.

MONTVILLE, ME.—The Knox & Montville Telephone Company has been incorporated with a capital stock of $10,000. The president is J. H. Vose, of Knox, and treasurer, C. A. Hall, of Montville, Me.

DULUTH, MINN.—The Duluth Telephone Company contemplates constructing a conduit system in the business section of this city.

WHITE BEAR, MINN.—The White Bear Telephone Company has increased its capital stock from $10,000 to $30,000. Mr. J. H. Spink is president and W. Murray secretary.

PERTH AMBOY, N. J.—Three telephone companies have applied to the city council for franchises. The companies are the Hudson & Middlesex Telephone Company, Central New Jersey Telephone Company and the People's Co-operative Telephone Company.

JERSEY CITY, N. J.—The stockholders of the New Jersey & New England Telephone Company met on March 4 and elected directors as follows: Robert C. Clowry, president; George W. E. Atkins, J. B. Bertholf, Thomas F. Clark, J. B. Van Every, E. M. Mulford and B. Brooks.

WEST UNION, [illegible]IO.—The Home Telephone Company has obtained a franchise for a local exchange.

ELIDA, OHIO.—The Elida Mutual Telephone Company has been incorporated with a capital stock of $21,000.

BLISSFIELD, OHIO.—The Hoagland Run Telephone Company, of Blissfield, has been incorporated with a capital stock of $5,000.

NORWALK, OHIO.—The Local Telephone Company has placed a contract with the Kellogg Switchboard & Supply Company, of Chicago, for a large central energy switchboard.

FITCHVILLE, OHIO.—The Fitchville Home Telephone Company is preparing to build lines to connect with New London, Greenwich, Clarksfield, Hartland and other towns.

BELLEFONTAINE, OHIO.—A number of farmers in the southern part of the county headed by J. J. Hostetler and Uriel Yoder have formed a company and will build a mutual telephone system.

MARION, OHIO.—The Marion County Telephone Company has increased its capital stock from $100,000 to $250,000. The proceeds of the sale of stock will be used to extend the system of the company.

GALION, OHIO.—John Pommert, proprietor of the Caledonia Telephone Company has purchased all the lines and rights of the Martel Telephone Company. A number of extensions will be built this summer.

CANTON, OHIO.—The Stark County Telephone Company has elected these officers: F. S. Dickson, president; H. A. Cavanaugh, vice-president; R. W. Judd, treasurer; A. S. Hillhouse, secretary and manager. It was decided to spend $48,000 in development work.

DEFIANCE, OHIO.—C. R. Shuter, of Evansport, has obtained a five-year lease on all the country lines belonging to the Northwest Telephone Company. He will organize the Home Telephone Company, of Defiance, and extend its service to adjoining counties.

SHELBY, OHIO.—Directors of the Oceana Telephone Company have declared a special dividend of 10 per cent. in addition to the 6 per cent dividend paid during the past year. After charging off $1,058 for depreciation there still remains a surplus of $1,000 from earnings.

SPRINGFIELD, OHIO.—The Bushnell syndicate, of Springfield, has acquired an interest in the Springfield-Xenia Telephone Company and will push the Springfield exchange to completion. The system will be connected with the lines of the United States Telephone Company.

NORWALK, OHIO.—The Business Men's Association has voted against paying the increase in rates demanded by the Central Union Telephone Company and if the company persists in the new rates the members of the organization will order the Bell telephones discontinued.

CLEVELAND, OHIO.—The condition of the Cuyahoga Telephone Company is improving rapidly under the new management. The statement for January shows gross earnings $32,646; operating expenses, $17,619; net earnings, $15,026; fixed charges, $9,985; surplus, $5,041.

ENOREE, S. C.—The Enoree Bell Telephone Company, capital $625, has been chartered by M. C. Poole and others.

COLUMBIA, S. C.—The South Carolina Long Distance Telephone Company, of Columbia, has completed connections with Rock Hill, 100 miles distant.

MEMPHIS, TENN.—The consummation of the big scheme of the Memphis Long Distance Telephone Co. is progressing apparently very satisfactorily. It is said that $200,000 worth of supplies have been purchased. The company is projecting one of the most extensive long distance systems in the South. Meetings have been held of independent telephone men in other cities looking to a consolidation of interests in accordance with the plans of the Memphis company. C. E. Stinson is president of the company. Those interested already own independent systems in a number of other cities.

SALT LAKE CITY, UTAH.—Whittemore Bros. & Ballinger have sold their independent telephone line between Price and Ferron, Utah, to Levi N. Harmon, A. E. Wall, Oliver J. Harmon and Albert Bryner.

SALT LAKE CITY, UTAH.—A telephone and electric light franchise have been granted by the county commissioners to R. W. Crockett and associates. The company proposes to build a telephone line connecting several towns of the county and extend its system through eastern Utah and connect with other lines.

ALEXANDRIA, VA.—The Mount Vernon Telephone Company has been incorporated to establish a telephone system in Fairfax County. The capital stock is $5,000. The officers of the company are as follows: J. N. Gibbs, president; F. H. Wilkins, secretary and treasurer, and Messrs. E. O. Thompson, C. Lukens, and S. B. Moore, directors. All of the officers are of Fairfax County.

BUCKHANNON, W. VA.—The Upshur County Telephone Company, of Buckhannon, has been incorporated with a capital stock of $25,000. The names of the incorporators are J. W. Downs, C. E. Downs, G. V. Downs, Buckhannon, W. Va., Dr. H. S. Yost, Amos, W. Va., W. H. Veach, Framington, W. Va.

GLENWOOD, WIS.—The West Wisconsin Telephone Company has been incorporated with a capital stock of $5,000. The names of the incorporators are Thomas Brockley, C. J. August and D. H. Syme.

ELECTRIC LIGHT AND POWER.

DE QUEEN, ARK.—The De Queen Light, Ice & Cold Storage Company has been incorporated with a capital of $50,000. J. S. Lake is president, I. O. Bunyon, secretary.

CORONA, CAL.—It is proposed to construct a municipal electric light plant, at a cost of $60,000. H. A. Wood is city clerk.

STERLING, ILL.—It is reported that the Sterling Gas & Electric Light Company will expend about $25,000 in improvements.

EDWARDSVILLE, ILL.—The directors of the electric light company agree to furnish the city sixty of the latest improved arc street lamps for a consideration of $500 per month for a ten-year franchise, the city to have the entire receipts from the commercial lights, the company to pay running expenses and turn the plant over to the city at the end of ten years for a nominal consideration. The proposition and the further consideration of the franchise granted at the last meeting of the council, which was vetoed by the mayor will be brought before the next meeting.

EAST ST. LOUIS, ILL.—An ordinance has been introduced in the East St. Louis City Council which is unique. It acknowledges that the city is entitled to conpensation for a valuable franchise, and provides for payment on a scale hitherto unheard of. The ordinance grants to the Interstate Transit Company the right to erect poles and string wires, and supply electric lights and power to East Side consumers. A clause provides that 2 per cent. of the company's gross earnings shall be paid into the city treasury. The Interstate Com-

pany, which operates the Eads Bridge automobiles and is now installing a new automobile service to be inaugurated some time in April, will become a competitor of the Clark syndicate in the lighting field as well as in the bridge passenger business. Owing to the fact that there has heretofore been no competition in lighting in East St. Louis complaint has been made of high rates. The Interstate Company announces that it will be ready upon the passage of the ordinance to begin the construction of its new plant.

HARTFORD CITY, IND.—Geo. Mayer and others, of Chicago, Ill., are reported to have purchased the plant of the Hartford City Light Company and will make improvements thereto.

LOGANSPORT, IND.—It is stated that an investigation by the mayor into the affairs of the municipal lighting plant revealed the fact that 127 consumers have never paid a cent for their light. It is stated that there has been great dissatisfaction with the service and some action will now have to be taken.

TAHLEQUAH, IND. TER.—C. W. Turner, owner of the electric light plant at Muskogee, is stated to have made a proposition to Tahlequah to establish an electric light plant. If it is accepted he will probably move the plant at Muskogee to Tahlequah and construct a larger plant at Muskogee.

COVINGTON, KY.—A contract has been awarded to the Union Heat, Light & Power Company to illuminate the city at $75 per light per year.

HOLYOKE, MASS.—The General Electric Company is stated to have secured a contract from this city for 400 series enclosed arc lamps and 150 multiple enclosed arc lamps for about $13,500.

NEGAUNEE, MICH.—It is stated that improvements are to be made to the electric light plant, at a cost of about $10,000.

STANDISH, MICH.—The legislature has been asked for permission for the issue of bonds by the municipality for a water works and electric lighting plant.

MONROE, MICH.—The Monroe Heating & Lighting Company is about to be organized with Chas. Flowers, of Detroit, and Fred C. Nadeou, of Monroe, as incorporators.

VERNDALE, MINN.—Bids will be received March 14 by the village council for $7,000 bonds to be used for constructing an electric lighting plant.

MANKATO, MINN.—It is stated that the city council has voted to construct a municipal electric light plant and will receive bids for $40,000 electric light bonds on March 19.

LINCOLN, NEB.—C. C. Wright, of Omaha, has petitioned the State Board of Irrigation for the right to use the waters of the Platte and Elkhorn Rivers for power purposes. It is estimated that the plant to be constructed will cost $1,500,000.

BUTLER, NEV.—The scheme for the establishing of an electric power plant on the Owens River is receiving the attention of a number of Eastern capitalists, who are heavily interested in the mines of the Tonapah district.

PITMAN GROVE, N. J.—The New Jersey Southern Gas & Electric Company, of Pitman Grove, has been incorporated, with a capital of $500,000, by J. H. McNeal, R. M. Anderson and A. M. Worstall.

DANSVILLE, N. Y.—The Mill Creek Electric Light & Power Company, of Dansville, has been incorporated with a capital of $200,000 by F. A. Owen, Walter A. Beecher and others, all of Dansville.

MECHANICVILLE, N. Y.—New water wheels are being installed at the water power plant of the Hudson River Power Transmission Company at this place. The old wheels were rated at about 500 hp each, while the new ones will generate about 1,000 to 1,100 hp each. New draft tubes, 7 feet in diameter, are also being installed, and other extensive changes and improvements are being made to the plant. Seven new wheels will be installed, aggregating 7,500 hp. The original plant was of only 3,500 hp capacity. The plant will be modernized throughout.

WALDO, OHIO.—Michel Brothers have obtained a franchise for an electric lighting system.

TIFFIN, OHIO.—Kerlin Bros., of Toledo, proprietors of the plant of the Consolidated Gas & Light Company, have decided to expend about $30,000 in improvements.

NORWALK, OHIO.—The Norwalk Electric Light & Gas Company has been absorbed by the Cleveland & Southwestern Traction Company which it supplies with current.

STRUTHERS, OHIO.—The local lighting company has submitted a proposition to the village, offering to furnish arc lights at $66 per lamp per year on a moonlight schedule.

HUBBARD, OHIO.—The citizens of Hubbard will vote on the proposition to issue $10,000 for the purpose of erecting a lighting plant in place of the one destroyed by fire some months ago.

LEESBURG, OHIO.—The Leesburg Manufacturing, Light, Power & Water Company has been incorporated, with $25,000 capital stock, by M. Reake, J. Worthington, H. A. Beeson, W. E. Dibble and R. P. Barrett.

ATTICA, OHIO.—The village council has authorized the sale of $6,000 worth of bonds for the purpose of erecting a municipal lighting plant. Contracts for the equipment will be placed in the near future.

WAUSEON, OHIO.—The Consolidated Heat & Light Company has been incorporated, with $100,000 capital stock, to install a lighting and heating plant in Wauseon. Incorporators: F. J. Bolinger, F. J. Spencer, C. P. Campbell, J. C. King and H. G. Struble.

OBERLIN, OHIO.—The Oberlin Electric & Heating Company has been incorporated, with $50,000 capital stock, to build an electric lighting and steam heating plant in Oberlin. Incorporators: A. M. Loveland, A. G. Comings, Y. D. Yocum, C. K. Whitney, L. B. Fauver and L. E. Burgner.

PIQUA, OHIO.—The Miami Light, Heat & Power Company has been incorporated, with $150,000 capital, to construct an electric light and heating plant in Piqua. Incorporators: S. B. Hartman, W. V. Baker and F. W. Bailey, Columbus, and H. T. Bailey, J. W. Brown and A. E. Clark, of Piqua.

COLUMBUS, OHIO.—The board of public works, of Columbus, has closed a contract with the Western Electric Company, of Chicago, for arc lamps and other apparatus, the price being $33,200, which was the lowest of five bids. The contract also calls for switchboards at a cost of $4,400. Director Immel is visiting cities where there are municipal lighting plants.

OTTAWA, OHIO.—The Ottawa Electric Light Company has submitted a proposition to the village whereby the company desires to lease its plant for a period of ten years for a monthly rental of $200, the city to maintain the plant and pay taxes. At the end of ten years the city may purchase the plant for $15,000 or may release it for another ten years on the same terms and conditions and at the end of the twenty years the plant is to become the property of the city.

TOLEDO, OHIO.—George W. Tonson, civil engineer for Toledo, has submitted to the council an estimate on the cost of a municipal lighting plant to supply 1,500 arc lamps. The estimates are: for building and foundations, $50,000; steam and electrical machinery, $102,000; conduits, $85,000; lines and poles, $75,000; arc lamps and fixtures, $35,000; engineering and other expenses, $15,000. Total, $383,500. The present contract with the Toledo Railways & Light Company expires in two years.

DONORA, PA.—The Donora Light, Heat & Power Company has been incorporated with a capital stock of $5,000.

CHAMBERSBURG, PA.—The citizens have voted to issue $25,000 bonds, of which $9,000 is to be used for improving the electric light plant.

SELLERSVILLE, PA.—The Sellersville Electric Light & Power Company has been incorporated, with a capital stock of $15,000, to be directed by Henry J. Wombold, of Telford; Morris H. Clymer, and Mamie E. Clymer.

CLINTON, S. C.—The Board of Aldermen is reported to have under consideration the construction of an electric light plant and water works.

SPARTANBURG, S. C.—The Electric Manufacturing & Power Company is about to be formed here with a capital of $100,000 by local capitalists, to develop the water power on French Broad River, 35 miles from this city and near Tyron, N. C. John B. Cleveland and J. N. Cudd are reported interested.

WALLA WALLA, WASH.—The Walla Walla Gas & Electric Company is preparing preliminary plans for the construction of a power plant on Walla Walla River.

WATERTOWN, WIS.—The Watertown Electric Company, Watertown, Wis., purchased recently a new street lighting equipment consisting of two 50-light series alternating circuits. The contract was awarded to the Western Electric Company of Chicago.

BERLIN, ONT.—The citizens are reported to have voted to purchase the electric light plant for $80,000.

WINNIPEG, MAN.—It is stated that the Canadian Pacific Railway Company will use electric lighting at all important stations in the mountains. Plants will be constructed at Banff, Field, Glacier, Lake Louise, Emerald Lake and at the hotel at Vancouver. The total cost of the work will be about $75,000. Edwin H. McHenry, Montreal, Que., is chief engineer.

THE ELECTRIC RAILWAY.

LITTLE ROCK, ARK.—A site has been selected for the new power house of the Little Rock Traction & Electric Company and the work of building the plant is to be begun soon. New machinery will be installed in the plant.

SANTA ANA, CAL.—Application has been made to the City Council by Collins & Scott for a franchise to build an electric railway from this city to Newport Beach.

ATLANTA, GA.—The Atlanta & Marinetta Electric Railway Company will apply for a charter. The capital will be $600,000. D. B. Gray, of New York, P. D. McCarley, of Fulton County, and others are among the incorporators.

ROCK ISLAND, ILL.—The Kewanee, Cambridge & Geneseo Railway Company will increase its capital stock from $100,000 to $850,000.

RUSHVILLE, IND.—The Indianapolis and Cincinnati Traction Company will locate its power house here. The equipment will cost $200,000.

LAPORTE, IND.—It is reported that Senator Mark Hanna is behind a movement to build an interurban line between South Bend and Chicago.

SHELBYVILLE, IND.—The stockholders of the Indianapolis, Shelbyville & Southeastern Traction Company have voted to extend the line to Greensburg and Batesville.

INDIANAPOLIS, IND.—The Knox, Chicago & Northern Traction Company has been incorporated. The capitalization is $150,000. J. C. Flecher, of Knox, is the president and financial head.

COLUMBUS, IND.—At the recent annual meeting of the Central Indiana Electric Railway Company the capital stock was increased to $200,000. A greater portion of the right of way has been secured.

INDIANAPOLIS, IND.—The Huntington, Columbia City & Northern Traction Company has filed articles of incorporation. Capital stock $50,000. John A. Knitz is president, W. A. Jones, vice-president, and B. E. Gates, secretary, all of Huntington.

KOKOMO, IND.—The Kokomo, Converse & Marion Traction Company has been incorporated with a capital of $10,000. O. V. Darby, G. E. Bruner and T. C. McReynolds, Kokomo, J. E. Kenney, Converse, and H. D. Thomas, of Marion, are the officials.

HUNTINGTON, IND.—Articles of incorporation are to be filed by the Huntington City, Columbia & Northern Traction Company. The capital is to be $50,000. The officers of the company are: J. A. W. Kintz, of Huntington, president; F. J. Heller, of Columbia City, vice-president; W. A. Jones, of Huntington, secretary; Benton E. Gates, of Columbia City, treasurer.

WINTERPORT, ME.—The Winterport, Frankfort & Prospect Electric Railway is seeking incorporation. Chas. A. McKenney, Frank C. Young, Charles R. Hill, of Winterport, and Albert Pierce, of Frankfort, are among the incorporators of the company.

CAMDEN, ME.—The Camden, Liberty & Belfast Railway Company has applied for a charter to build an electric railway through Camden, Liberty and Belfast, a distance of 20 miles. The power plant is to be located at Liberty. Capt. John J. Crowley, of Taunton, Mass., and Charles E. Littlefield, of Rockland, Me., are interested.

HAGERSTOWN, MD.—The Hagerstown Railway Company contemplates extending its lines into Berkely County and possibly as far as Martinsburg, W. Va.

HAVERHILL, MASS.—Permission has been granted to the Haverhill & Andover Street Railway Company to increase its capital stock to $190,000.

BEVERLY, MASS.—The Gloucester, Magnolia & Beverly Street Railway Company will apply for a franchise. Judge Edgar Tate, of Gloucester, is interested.

CHELSEA, MASS.—Application has been made to the Legislature for the incorporation of the Marginal Street Railway Company. The plan is to build a three-mile freight railway along the waterfront of the city. Jos. W. Stickney, of Chelsea, is interested.

DULUTH, MINN.—It is said that the Duluth-Superior Traction Company is planning to spend $200,000 in improvements.

ST. LOUIS, MO.—The large carsheds and 200 electric cars of the St. Louis and Suburban Railway Company were destroyed by fire on February 24. The loss is placed at $200,000.

LITTLETON, N. H.—The Littleton, Franconia & Bethlehem Electric Railway Company, to be capitalized at $100,000, is seeking incorporation. The plan is to develop Fifteen-Mile falls in the Connecticut River for power. A. S. Batchellor, of Littleton, is interested.

OLEAN, N. Y.—Interests identified with the Olean Street Railway Company are said to have in contemplation the construction of an electric railway from Bolivar to Little Valley.

GALION, OHIO.—The Ohio Central Traction Company has installed at its Galion power house a DeLaval steam turbine.

WEST UNION, OHIO.—Citizens of West Union and Portsmouth are forming a company to build a railway between West Union and Portsmouth.

COLUMBUS, OHIO.—The Central Market Street Railway Company is installing a storage battery plant in its West Mount Street power house.

CLEVELAND, OHIO.—C. H. Hubbell and A. E. Williams have applied to the County Commissioners for an electric railway franchise from South Brooklyn.

YOUNGSTOWN, OHIO.—The Pennsylvania & Mahoning Valley Railway Company will make important improvements to the city line of the New Castle Traction Company.

YOUNGSTOWN, OHIO.—John Stambaugh, Geo. Rose and other local capitalists are reported to be forming a company to build a new road to the plant of the National Steel Company.

CLEVELAND, OHIO.—The car barns of the Garrettsville division of the Eastern Ohio Traction Company, at Chagrin Falls, were destroyed by fire recently the loss aggregating $80,000.

ZANESVILLE, OHIO.—The Muskingum Valley Traction Company has been incorporated with $100,000 capital stock by S. A. Weller, W. B. Cosgrove, N. P. Shurtz, J. G. England and S. M. Winn.

MANSFIELD, OHIO.—The Citizens' Railway, Light & Power Company is reported to be planning to extend the Shelby-Mansfield line to Norwalk or Monroeville to connect with the Lake Shore Electric Railway.

SPRINGFIELD, OHIO.—The Springfield Southern & Cincinnati Railroad Company has been incorporated with $25,000 capital stock by George H. Frey, Jr., James Johnson, E. B. Hopkins, Charles R. Crain and J. D. DeWitt.

HAMILTON, OHIO.—Judge A. Caldwell, of Cincinnati, Herman Duhme, of Cincinnati, and James A. Mogaw, of Rising Sun, Ind., have in contemplation the construction of an electric railway from Hamilton to Richmond, Ind.

TOLEDO, OHIO.—The Interurban Construction Company is placing contracts for the building and equipping of the Toledo, Port Clinton & Lakeside Railway, for which it is contractor. The power house will be erected near Port Clinton.

CLEVELAND, OHIO.—The Lake Shore Electric Railway Company has contracted for about $150,000 worth of new equipment. Contract has been placed with the J. G. Brill Company, of Philadelphia, for ten new cars. The Kuhlman Car Company, of Cleveland, is building for this company two very fine interurban cars to replace two which were destroyed by fire some weeks ago.

FOSTORIA, OHIO.—The Toledo, Fostoria & Findlay Railway Company has placed $1,000,000 in bonds with Toler & Higgins, of New York, and a contract has been closed with J. G. White & Co., New York, for the immediate construction of the extension from Fostoria to Toledo. The line will be 32 miles in length and will be wholly on private right of way which has been secured.

WILDMAN, OKLA.—A company with a capital of $50,000 will construct an electric railway to connect Mountain Park and Wildman, a distance of about 15 miles.

HUMMELSTOWN, PA.—Application has been made for a charter for the Hummelstown & Campbellstown Street Railway Company.

LANCASTER, PA.—The Lancaster & Rocky Springs Railway Company has authorized appropriations for the erection of an extra 450-hp rotary converter station.

PHILADELPHIA, PA.—The Philadelphia Rapid Transit Company, it is stated, will let the contract for the building of the section of subway in Market Street between Fifteenth St. and the Schuylkill River.

ALLENTOWN, PA.—The Siegfried & Danielsville Electric Railway Company has secured a charter to build a 16-mile line from the terminus of the Lehigh Valley Traction Company's line at Siegfried to Hazard. The company is capitalized at $250,000.

MT. HOLLY SPRINGS, PA.—It is said to be the purpose of the Carlisle & Mt. Holly Electric Railway Company to extend its lines from Mt. Holly to Hunter's Run, a distance of several miles. Col. Patricio Russ, president of the company, states that work will shortly be commenced on the new light, heat and power plant here

ALLENTOWN, PA.—At the recent annual meeting of the Allentown & Reading Traction Company a number of important improvements were decided on. A new engine and generator are to be added to the power plant at Kutztown, the storage battery station at Blandon is to be enlarged, and the line is to be double-tracked between Dorney's Park and Allentown.

WATERTOWN, S. D.—The City Council has granted a franchise to the Watertown & Lake Kampeska Railway & Transportation Company.

WACO, TEX.—Plans are being discussed for building an electric railway to traverse Hamilton, Comanche, Bosque, Hood, Somerwell, Johnson, Hill, Tarrant and Dallas counties. J. W. Riggins, of Waco, is interested.

SPRINGVILLE, UTAH.—The council has granted an electric railway franchise to Reed Smoot and Jesse Knight.

RICHMOND, VA.—It is said that the Richmond Passenger & Power Company has authorized the expenditure of $50,000 in increasing its power facilities.

RICHMOND, VA.—The Virginia Passenger and Power Company has decided to sell its old plant on Johnsons Island, which is valued at $100,000. The new additions to the company's plants elsewhere will fully compensate for the loss of the old plant. Pres. Sitterding has received a proposition from G. C. Jacobs, of Chesterfield County, Va., for power for two projected manufacturing plants. The company has let the contract for a new power plant in Richmond to W. B. Newell for $25,000.

RUTLAND, VT.—Leroy M. Baldwin, 88 Wall St., New York, N. Y., is reported interested in the construction of a combination electric and steam railroad from Rutland to Randolph.

VERGENNES, VT.—John J. Flynn, of Burlington, is reported to have purchased water rights here and contemplates constructing an electric railway to connect Vergennes and nearby towns.

WHEELING, W. VA.—The Wheeling, West Liberty & Belt Railway Company has been incorporated. Among the incorporators are C. L. Gill, Will Chambers, Will Gutman, James W. Ewing and E. Ball.

APPLETON, WIS.—Anchor ice recently clogged the water wheels of the power house of the Wisconsin Traction, Light, Heat & Power Company, cutting off electric light and power for several hours.

LA CROSSE, WIS.—Interests identified with the La Crosse Street Railway Company have just incorporated the Lacrosse & Northern Railway Company, which will build an electric railway from La Crosse to Winona.

DEPERE, WIS.—The Knox Engineering Company, of Chicago, Ill., is reported to have secured a franchise in Depere for an electric railway which it proposes constructing between Kaukauna and Green Bay. The Fox River Electric Railway and Power Company proposes to extend its line into Depere.

CHATHAM, ONT.—N. H. Stevens, president of the Canada Flour Mills, is reported interested in the construction of an electric railway through Kent County.

HAMILTON, ONT.—The Hamilton Cataract Power, Light & Traction Company has been incorporated to take over the Hamilton Light & Cataract Power Company. The capacity of the power plant at De Cews Falls will be increased at once.

NEW INDUSTRIAL COMPANIES.

THE CHATTANOOGA ELECTRIC COMPANY has been incorporated at Trenton, N. J., with a capital stock of $750,000.

THE ELECTRIC BULLETIN COMPANY, of Cincinnati, Ohio, has been incorporated, with $15,000 capital, to deal in electrical appliances.

THE HOLT ELECTRIC COMPANY, of Carthage, Mo., has been incorporated by Robert Holt, J. M. Long and others. The capital stock of the company is $10,000.

THE TELEPHONE TUBE COMPANY has been incorporated at Portland, Me., with a capital stock of $100,000. F. A. Newell, of Boston, is president and H. L. Cram, of Portland, is treasurer.

THE CHICKASHA WAREHOUSE & TERMINAL COMPANY has been incorporated at Chickasha, Ind. Terr., to build steam and electric railways, telephone lines, etc. M. M. Beavers and L. M. Stone, of Chickasha, are interested.

THE AUTOMATIC ELECTRIC PUMP COMPANY, of New York City, has been incorporated with a capital stock of $20,000. The directors are Horace G. Kimble and Edmund J. Fenn, of Brooklyn, and Fred White, of New York City.

THE MAINE ELECTRIC COMPANY has been incorporated at Portland, Me., to make and deal in electrical supplies. The president is J. B. Phillips and the treasurer A. J. York, both of Portland. The capital stock of the company is $10,000.

THE TROLLEY SUPPLY COMPANY, of Canton, Ohio, has been incorporated, with $1,200 capital stock, by J. E. McLain, W. S. Roath, A. W. Knutson, R. K. Fast, P. F. McDermit and P. L. McLain. They will manufacture electric railway line material.

THE J. G. WHITE COMPANY has filed a certificate of incorporation in Bridgeport, Conn., for the purpose of conducting an electrical and contracting business. The authorized capital stock of the company is $2,000,000, and the incorporators are Lewis B. Grant, of Brooklyn; Richard F. Kiniery and Ashley T. Cole, of New York.

THE MERCEDES COMPANY, of New York City, has been incorporated at Albany, with a capital stock of $2,700,000, to manufacture automobiles, launches, yachts and other self-propelling vehicles. The directors are Edward Bernhard, Philip Ahrens, C. B. Wynkoop, and James T. Arnold, of New York City; Philip Huetwohl, of Brooklyn, H. Smith, of Plainfield, N. J., and Theophilus Parsons, of Hempstead, L. I.

LEGAL.

GILMORE SOCKET SUIT.—The General Electric Company's suit against the Gilmore socket has been decided in favor of that company and an injunction has been asked. The suit was brought against Henry A. Truitt trading under the name of the Imperial Electric Company.

PREPAYMENT TELEPHONES.—The suit brought by William E. Berryman to test the right of the Kinloch Telephone Company to prohibit the nickel-in-the-slot devices to be used in connection with its telephones has been decided in favor of the company. Judgment for $1 damages was given against the company for tearing down a controller regulating a nickel-in-the-slot apparatus which was used with the instrument. Berryman took a non-suit on the claim for damages and filed an application for a new trial.

PERSONAL.

MR. W. J. LEE, of Washington, has been appointed telegraph manager for the new Department of Commerce and Labor.

MR. L. B. STILLWELL, consulting engineer of the Manhattan and other systems, is taking a well-earned holiday in Florida.

MR. B. A. BEHREND, chief engineer of the Bullock Electric Manufacturing Company, is making a visit to the Pacific slope.

MR. SEATON M. SCOTT is conducting the factory of the Storey Motor & Electric Company at Harrison, N. J., as superintendent.

MR. F. V. L. TURNER has become general manager of the Cuyahoga Telephone Company, of Cleveland. He was formerly in the independent exchange at Atlanta, Ga.

DR. LEE DE FOREST visited Cleveland recently and while there stated that a wireless telegraph plant will be erected at Euclid Beach Park, with two towers each 200 feet high.

MR. E. R. KNOWLES, C. E., has been retained as consulting engineer for the Carnegie Libraries for the Borough of Brooklyn; and also for the Massachusetts Portable Security Vault Company.

LORD KELVIN, Mr. Marconi, Lord Charles Beresford and U. S. Naval Attaché Capt. Clover, occupied a round table together at the recent banquet of the Pilgrim Club in London to Ambassador Choate.

MR. J. R. BEETEM, vice-president and general manager of the New York & Queens County Electric Railway, which is said to have passed under Belmont and Interborough control, has resigned his position.

MISS LEILA LIVINGSTONE MORSE, grand-daughter of Prof. S. F. B. Morse, and niece of Mrs. Franz Rummel, gave two song recitals with David Dexter in the Astor Gallery at the Waldorf-Astoria during the past week.

MR. E. H. DEAN, chief electrical engineer of the Primitiva Gas & Electric Light Company, Buenos Ayres, Argentine Republic, which operates the largest electric lighting plant in that part of the world, has resigned his position.

MR. E. A. DARLING, who was injured by the explosion at the Edison Cement Works, is improving rapidly and will show no scars on his face, but may have a few on the hands. Mr. R. H. Goodwilly, who was severely injured, is improving slowly.

MR. E. H. JOHNSON, who has been in England for some time past pushing the interests of the Johnson-Lundell electric railway patents, is again in this country and is at present in New York, renewing acquaintance with a very wide circle of friends.

MR. H. H. ROBINSON, heretofore assistant general manager of the United States Telephone Company, of Cleveland, has been appointed general manager succeeding Maxime Reber who will devote his time to developing the properties of the Federal Telephone Company.

MR. CARL KINSLEY, instructor in physics at the University of Chicago, has contributed a paper entitled "A Systematic Method of Calculating the Dimensions of Direct-Current Dynamo-Electric Machines" to Vol. IX of the "Decennial Publications" of the University.

MR. R. T. LOZIER, sales manager of the Bullock Electric Manufacturing Company, of Cincinnati, is recuperating from winter labors and has gone to Florida, down the west coast to Manible Island, hoping to bring back some big fish by April 1, or at least some big fish stories.

MR. S. FAIRFAX CUTHBERTSON, representing the Marconi system is in the United States preparing a wireless telegraphic code for publication to be used in transatlantic messages. The code will be complete in every respect and will be similar in purpose and extent to the Western Union and Postal Telegraph codes.

MR. W. J. HAMMER lectured before the Franklin Institute of Philadelphia recently, and has had the pleasure of receiving a letter from Dr. W. H. Wahl, the secretary, as to the unique amount of valuable and interesting data on electrical advances contained in the lecture, which was based on Mr. Hammer's recent observations abroad.

MR. LIVINGSTON EMERY, son of the late Chas. E. Emery, has associated himself with Henry D. Williams, Esq., and Herbert E. Gibbs, Esq., as counselor at law and solicitor of patents. Mr. Emery is entered in Great Britain as barrister at law, and has special connections in the other principal European countries for taking out patents.

MR. EDWARD P. BURCH, on Feb. 25, lectured before the senior class of the University of Minnesota on "Central Station Design." The lecture outlined the design of the electric light, railway and water plant at Everett, Wash., and brought out the relation between the excellent financial results in operation and the several features of the design.

MR. CHARLES P. STEINMETZ is the subject of a very interesting article in the March number of "Success," and a similar article appeared in the *New York Sun* on March 8. The personality and characteristics of the man are brought out in both very clearly, in a popular style. The details of Mr. Steinmetz's career in Germany as a revolutionist are quite amusing.

MR. ARTHUR B. LISLE, who for ten years past has been connected with the Narragansett Electric Lighting Company, of Providence, R. I., as sales and collecting agent, etc., has been appointed by President Perry as assistant general manager, and has assumed the duties of his office. For two years he had charge of the company's property known as the Bristol County Gas & Electric Company.

MR. T. A. EDISON, who has been in Florida for some time on a vacation, will remain South for another month. Mr. W. S. Mallory, vice-president of the Edison Portland Cement Company, at the works of which a fatal explosion recently occurred, has gone to Florida with the head draughtsman of the works to arrange for some new work. The loss by the explosion is stated not to exceed $15,000.

MR. W. J. CLARK, manager of the foreign department of the General Electric Company, sailed for Europe this week on Wednesday, after a brief visit to this country. During a recent trip to Connecticut where he once did interesting pioneer electric railway work in the Naugatuck Valley, a dinner was given in his honor attended by several old friends, leading officials in the State judiciary, legislature, etc.

MR. C. REVILL BELLAMY, general manager of the corporation tramways of Liverpool, England, was the guest of President J. C. Hutchins, of the Detroit United Railway last week. Mr. Bellamy is in America studying the operation of electric railways. Within a radius of a few miles of Liverpool there are fully thirty towns and cities without interconnection by electric roads. The American interurban service is one of the chief features about which Mr. Bellamy is seeking information. He sails this week.

MR. GEORGE W. MANSFIELD and Mr. J. M. Klingelsmith have formed the Eastern Electric Contract Company with headquarters at the Board of Trade Building, Boston. Mr. Mansfield is a well-known pioneer in the electric railway field, and was actively associated with the Daft and Thomson-Houston Companies. Mr. Klingelsmith is also an old electric railway man, and has been connected with Thomson-Houston, General Electric, Westinghouse and Stanley interests as well as with the banking business.

PROF. MORGAN BROOKS, of the electrical engineering department of the University of Illinois, informs us that important extensions of the engineering facilities are proposed in case the university should secure from the Legislature an appropriation of $300,000 or part of that amount. The university now stands sixth in the country in the number of its engineering students. The friends of the institution hope earnestly that it will be able to secure the funds needed for its work.

MR. EDWARD R. MASON, son of Mr. W. R. Mason, of electrical supply fame, has just been made vice-president of the electrical supply firm of Porter & Berg, of Chicago, recently incorporated. This concern makes a specialty of manufacturing and dealing in electric railway supplies. Mr. Mason was with his father in the same lines for a number of years, and has studied this branch of the industry thoroughly. He is a lieutenant in the naval militia of Illinois and a graduate of the nautical school.

NEW YORK ELECTRICAL SOCIETY.—The following new members were elected at the last meeting: Axel O. Bendichsen, Wm. C. Hall, Jr., Clarence R. Dean, Henry M. Bascom, Albert E. Blackman, Joseph Guttman, Wm. Hogan, Richard J. Riedl, William Mackay, Norman K. Althause, William W. Cully, Alfred W. Bourgeois, Alfred R. Tahl, Frank Gardner, Alfred J. Thompson, Emile C. Boerner, Jr., T. P. Teale, Jr., M. S. Clawson, G. W. Hallock, Alonzo C. Bell, Alfred W. Eckhoff, W. C. Minier, Bernard B. Neal, Chas. V. Walter, A. Th. Moberg, Harry J. Smith.

MR. MARCONI.—The birth of Marconi has been found registered in Bologna, as previously understood; Florence has discovered that the inventor went to school there between his sixth and tenth years. An aged lady, Signora Luisa Cavallero, who taught young Marconi how to read, was sure that she saw in the "inglesino," as she called him, the embryo man of genius. Nevertheless, she was obliged to punish him many times because he was very naughty, and since he has become a great man her conscience has severely reproached her. "Fancy, punishing a genius!" she exclaimed. "At the same time," she added in extenuation, "he was never able to learn anything by heart. That was impossible with him."

MR. S. E. MOFFETT, in a recent article in *McClure's Magazine*, says: Inch by inch the field is contested, and slowly, sullenly, the locomotive is giving way before the insistent trolley. A dozen years ago it was only the car horse and the cable in the towns that were threatened by electric traction. Then the trolley poked an inquiring tentacle over the city limits into the suburbs. The results were satisfactory, and swiftly the electric lines flung their spider filaments from town to town, until now great sections of the country are cobwebbed with them. The trolley map of eastern Massachusetts looks as complete as the steam railroad map. If you have a little time to spare you can go on an electric car to almost any part of southern New England that you could reach by a locomotive, and to a good many parts that you could not.

Trade Notes.

OIL FILTERS.—The American Locomotive Company has just sent to the Burt Mfg. Co., of Akron, Ohio, its fifth order for oil filters to be used at its works in Schenectady, N. Y.

THE ELECTRIC FURNACE for metal work in iron and steel is to be the subject of the first of four special monographs issued by the *Mois Scientifique et Industriel* now published at 8 Rue Nouvelle, Paris. The second monograph will be devoted to the industrial applications of cold.

CENTRAL ELECTRIC CO.—A complete line of Faries shades are carried in Chicago stock by the Central Electric Company which is, therefore, in a position to make prompt shipments. The above company has also a large stock of Duplex lamp guards for which it is quoting attractive prices.

WIRELESS TELEGRAPHY ON TRAINS.—It is stated that the New York Central & Hudson River Railroad Company has given permission to the De Forest Wireless Telegraph Company to equip the "Twentieth Century Limited" with wireless apparatus. Experiments will be continued for two months, beginning April 1.

THE ELECTRIC APPLIANCE COMPANY, Chicago, general sales agent for the Gutmann alternating current wattmeter, is enthusiastic over letters and reports of tests which it has just received from Europe. The Gutmann meters sent for comparative tests with all other makes of wattmeters, both domestic and foreign, easily carried off the honors.

KILBURN, CLARK & COMPANY, of Seattle, Wash., have been made the Pacific Coast sales and distributing agents of the Nernst Lamp Company, of Pittsburg, and have established branch offices in San Francisco and Los Angeles, Cal. The increasing volume of business from that section of the country has made necessary special attention to its demands.

THE NORTHERN ELECTRICAL MANUFACTURING COMPANY, Madison, Wis., has just issued a booklet on the subject of its direct-current generators of both the engine and belt types. The general features of construction are pointed out and some illustrations show some of the special features of design. A copy of the booklet will be sent free on request.

THE BANNER ELECTRIC COMPANY, of Youngstown, Ohio, is preparing to erect a three-story building, 68x110 feet. At present the company manufactures about 4,000 incandescent lamps per week, but this output will be increased when the new building is completed. The company recently secured several large contracts for lamps which rendered the extensions necessary.

THE NATIONAL STAMPING WORKS, Chicago, Ill., repairs all standard makes of dynamos, motors, transformers, meters, arc lamps, etc. Its enclosing attachment is adapted for use on all makes of high-tension series open arc lamps, and it is stated, prolongs the life of the carbons 15 to 20 times. The company manufactures a full line of gas, electric and combination fixtures. Its catalogue gives illustrations and information.

EBONITE.—E. M. Ashmore & Co., 30 Miami Avenue, Detroit, Mich., have issued a booklet containing copies of a few letters from customers using Ebonite. This commutator compound is evidently giving satisfaction to all who are using it. It is claimed that it lubricates the commutator without gumming the brushes and prevents sparking and cutting. The firm will be glad to send a copy of the booklet to all interested in the subject.

THE FOREST CITY PAINT & VARNISH COMPANY, of Cleveland, Ohio, is sending out a handsome catalogue and color sheet illustrating its line of paints particularly adapted for poles, bridges and depots as well as japans for finishing car bodies. The Cleveland concern is particularly strong on these lines and railway managers planning spring improvements requiring paint should not fail to secure a copy of this booklet.

PLUNGER ELEVATORS.—We have received the catalogue of the Plunger Elevator Company which has just come from the press. Although the principles of construction of the plunger elevator are generally known, it will probably be news to most of our readers that there are installations of these elevators where the car travel exceeds 200 feet, as for example, in the Ansonia apartment building in New York, illustrated on page ten of the brochure.

A MODERN SHAPER.—A few hints about a modern 16" shaper of the Garvin type are given in a booklet recently issued by the Garvin Machine Company, New York. This particular machine is illustrated and several detail views are shown. The features of the machine are pointed out progressively in accompaniment with the illustrations. The Garvin Company has also issued recently a folder illustrating and briefly describing its complete line of metal-working machine tools.

THE COLUMBIA ELECTRIC & MFG. CO. is now located in its new factory at High St. and Boyden Place, Newark, N. J. This is one of the most completely equipped manufacturing plants in the country and with new and special machinery the company is able to turn out more of its well-known Columbia arc lamps to meet the ever-increasing demand. All Columbia lamps are interchangeable from direct to multiple or alternating and are sent on trial. All lamps are guaranteed.

VEGETABLE BOILER COMPOSITION.—The Arlington Manufacturing Company, Canton, Ohio, has issued a pamphlet descriptive of its vegetable composition for use in marine, tubular and water tube boilers as a preventive of incrustation, scale, corrosion and pitting. These compositions are vegetable extracts which convert the lime and magnesia in the water, holding them in suspension in the form of a light precipitate which is blown or washed out of the boiler and thus preventing scale formation.

A SHORT CIRCUIT.—The Ohio Brass Company recently issued a circular containing an illustration of a straight line trolley hanger and a section of trolley ear which were subjected to a dead short circuit of 1500 amp. at 500 volts. A considerable portion of the ear was melted away, but the point of particular interest is the manner in which the "Dirigo" insulation withstood this great heat. This severe test occurred on the Millcreek Valley Street Railroad Company, St. Bernard, Ohio, and speaks well for the insulation of the Ohio Brass Company.

THE FRINK SYSTEM OF REFLECTORS are perfection for lighting pictures in galleries and private houses and are coming more and more into use. The Frink Company has recently completed the installation of its reflectors in the American Art Galleries, New York, also in the new galleries of the Drexel Institute in Philadelphia and has just finished putting them in the delivery room of the Boston Library for the purpose of lighting Mr. Abbey's "Holy Grail" decorations. Such commendation is sufficient to establish the merit of the Frink reflectors.

THE CRESCENT COMPANY, of Chicago, is manufacturing two new specialties. One of them is the Crescent soldering stick, which has, it is claimed, an entirely new combination of ingredients in its make-up. It is quick acting and economical, due to the small amount required. This stick is not brittle, but rather flexible without being soft, and as a result of this quality the entire stick may be used without waste due to crushing and crumbling. The other specialty is the Crescent paste, which is also an entirely new combination of soldering agents with a neutral mineral wax. The principal advantage of this paste, claimed by the manufacturer, is the small amount of heat required with consequent saving of time and the economical use of flux.

THE AMERICAN TOOL COMPANY.—Recent changes in the personnel of the American Tool Works Company, of Cincinnati, have placed the management of the business in the following hands: Mr. Franklin Alter, president; Mr. Henry Luers, secretary and treasurer; Mr. J. B. Doan, general manager; Mr. A. E. Robinson, general superintendent. The month of February resulted in next to the largest month's business in the history of the company. The plant is exceptionally busy in all departments, and the outlook is very bright. Extensive alterations and improvements are now being made, adapted to the company's increasing business. It has just brought out several new tools, and is much gratified at the success attending their introduction.

HOOPES CONDUCTIVITY BRIDGE.—To copper mining companies, manufacturers of insulated wires and cables, and to the users of such material it is important to measure conductivity accurately. A new device for this purpose is the Hoopes conductivity bridge, designed by Mr. William Hoopes, electrical engineer of the Pittsburgh Reduction Company. The apparatus proved so satisfactory that arrangements have been made to place it on the market, and it is now manufactured by Morris E. Leeds & Co., of Philadelphia. James G. Biddle (as sole agent for Leeds & Co.) has published a comprehensive illustrated descriptive pamphlet (No. 430), which should be secured by all engineers interested in the subject. Mr. Biddle's address is 1024 Stephen Girard Building, Philadelphia.

INCANDESCENT LAMPS.—Amongst the manufacturers of high-grade incandescent lamps that are rapidly coming to the front is the Germania Electric Lamp Company, of Harrison, N. J. This company has been in existence for about two years and its endeavors during that period have been mostly along experimental lines and the perfecting of a very high grade incandescent lamp, in a factory fully equipped with the latest improved machinery and scientific appliances in the hands of skilled operatives. Every process of manufacture is followed with the utmost care and each lamp is fully tested after each operation by competent and experienced inspectors. The present works of the Germania Electric Lamp Company are especially well situated for shipping facilities with both railway sidings and dock privileges and the company is now in a position to fill orders promptly.

THE DOUBLEDAY-HILL ELECTRIC COMPANY, Pittsburg, Pa., is now completely settled in its new eight-story building at 919 Liberty St., whither it has recently moved. This is one of the largest buildings in the United States devoted exclusively to the handling of and dealing in electrical supplies and specialties. The company has a much larger stock than it ever had. Practically everything in the electrical supply field is contained somewhere within the eight stories and basement. Of course a perfect system of receiving and handling orders is necessary in an establishment of this sort, and the Doubleday-Hill people feel that they have evolved one which is equal to all the requirements. This means that every order received is carefully followed through the various departments, a rigid system of checking up having been instituted which insures a correct packing of the supplies and specialties ordered, and which further extends to the shipping department, guaranteeing shipments of orders the same day as received. The company has been very successful in this business in Pittsburg and vicinity and is agent for several of the well-known manufacturers.

WESTON INSTRUMENT COMPANY'S NEW YORK OFFICE.—For the greater convenience of its numerous customers and to better care for the continued increase of business in New York and vicinity, the Western Electrical Instrument Co., Waverly Park, Newark, N. J., has opened a New York office at 74 Cortlandt St., under the management of Mr. Caxton Brown, who has a theoretical as well as practical knowledge of the different instruments manufactured by the company and their particular adaptabilities. This will enable any purchaser or any person visiting or doing business in New York who may wish to make inquiries relative to electrical measuring instruments, to come in direct contact wth a man who is properly qualified to answer such inquiries. There will be a show room in connection with the New York office in which will be exhibited the different types of instruments and their special uses; also the individual parts which make up the instruments. Besides being a great convenience to customers the New York office will eliminate much correspondence in the nature of inquiries, thus reducing time of delivery of orders. A general impression has prevailed that the Weston Electrical Instrument Company only made voltmeters and ammeters. This is not the case. The company is particularly fitted to turn out work of any special character in which the highest excellence of mechanical and electrical work and design are the important features. It has in fact been turning out a large amount of special laboratory apparatus for several years past and is now prepared to make standard cells, standard resistances, galvanometers, and the highest grade of special bridge work, speed indicators, etc.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 3, 1903.

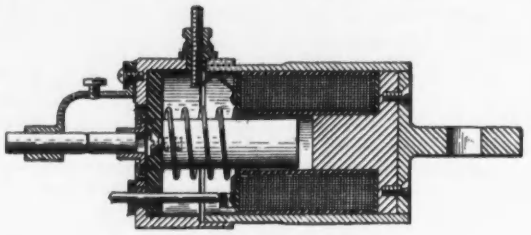
[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

12,090. TESTING SYSTEM FOR TELEPHONE-LINES; W. W. Dean. Chicago, Ill. Original app. filed Jan. 6, 1903. (See page 445.)

721,669. ELECTRIC ENGINE; W. T. Clark, Schenectady, N. Y. App. filed Oct. 1, 1902. An arrangement of a magnet coil and movable core to act as a plunger, in a casing, and a switch for interrupting the current to obtain a reciprocation of the plunger.

721,670. ELECTRIC ENGINE; W. T. Clarke, Schenectady, N. Y. App. filed Oct. 1, 1902. An arrangement of two coils within a casing acting upon a common plunger together with suitable switching apparatus.

721,678. MAGNETIC CLUTCH; E. R. Douglas, East Orange, N. J. App. filed July 14, 1902. A part of the clutch body carrying one of the pole faces, slides, to compensate for frictional wear and insure uniform contact between the parts when the circuit is closed.



721,669.—Electric Engine.

721,679. MAGNETIC CLUTCH; E. R. Douglas, East Orange, N. J. App. filed July 28, 1902. A modification of the preceding patent, involving a clutch in which a single rotary member may be made to engage at will with any one or more of several co-acting rotary members.

721,682. REVERSIBLE GALVANIC BATTERY; T. A. Edison, Llewellyn Park, N. J. App. filed November 28, 1902. (See page 444.)

721,689. MEANS FOR PROTECTING GAS OR VAPOR ELECTRIC LAMPS; S. E. Flichtner, Englewood, N. J. App. filed June 12, 1902. In order to protect the vapor tube from being fractured by the shock of mercury during transportation, a chamber connected with the lamp at one end by a neck is provided for containing the mercury in transit.

721,703. ELECTRIC FURNACE; P. L. T. Heroult, La Praz, France. App. filed October 11, 1900. (See page 444.)

721,708. TELEPHONE-TRANSMITTER; A. F. Lawson, Buffalo, N. Y. App. filed August 6, 1900. (See page 445.)

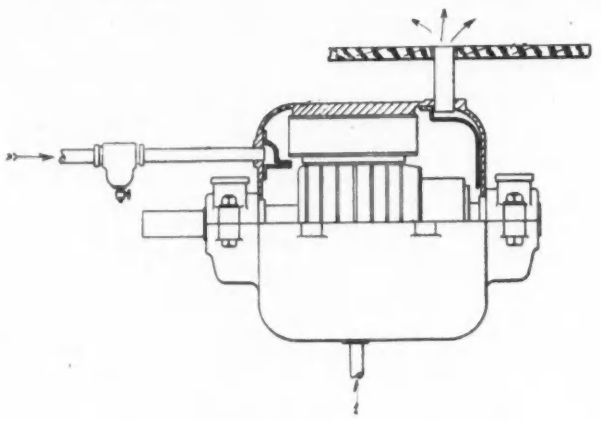
721,713. GRAPPLING DEVICE FOR MANDRELS FOR CONDUIT SECTIONS; R. W. Tyle, New York, N. Y. App. filed Oct. 17, 1902. The device is provided with a slotted funnel with which the head of the draw-rod engages.

721,734. WIRE HOLDER FOR TROLLEY WIRES OR ELECTRIC RAILWAYS; L. Von Orth, Berlin, Germany. App. filed Dec. 26, 1901. Details.

721,741. PROTECTING DEVICE FOR GAS OR VAPOR ELECTRIC LAMPS; M. Von Recklinghausen, New York, N. Y. App. filed March 28, 1902. To protect a vapor lamp, a specially constructed pocket is provided for containing the mercury during transportation.

721,742. TROUBLE-TEST FOR AUTOMATIC TELEPHONE SYSTEMS; F. N. Reeves, New York, N. Y. App. filed February 15, 1902. (See page 445.)

721,774. PLURAL LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed May 30, 1898. This patent and those which follow in the same name discloses a multiple lamp socket for a bunch of lights, the general arrangement being an external dome-like shell having integral sockets, all of which are connected with one side of the circuit, and a central internal plate or carrier against which all of the lamp necks strike and which is connected with the other side of the circuit.



721,877.—Railway Motor Ventilating System.

721,775. PLURAL LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed Dec. 9, 1901. See Patent 721,774.

721,776. PLURAL LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed May 20, 1898. See Patent 721,774.

721,777. PLURAL LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed Feb. 7, 1902. See Patent 721,774.

721,778. PLURAL LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed July 18, 1902. See Patent 721,774.

721,779. PLURAL LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed July 18, 1902. See Patent 721,774.

721,780. CLUSTER OF PLURAL LAMP SOCKETS; R. B. Benjamin, Chicago, Ill. App. filed July 18, 1902. See Patent 721,774.

721,794. TROLLEY; W. H. Goodyear, Wilkinsburg, Pa. App. filed March 18, 1902. Details.

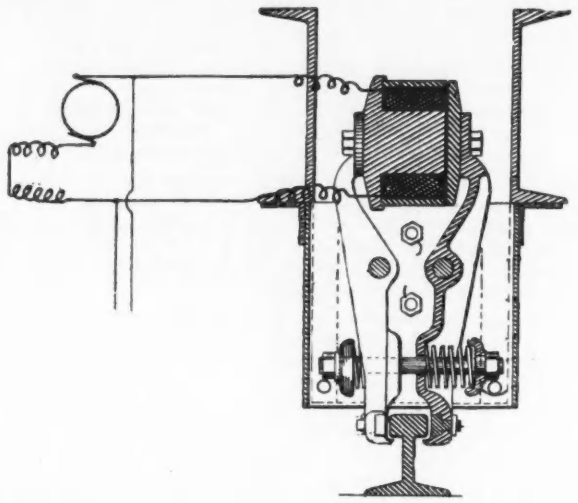
721,817. TELEPHONE-TRANSMITTER; L. Mellett, Somerville, Mass. App. filed June 6, 1902. (See page 445.)

721,877. RAILWAY MOTOR VENTILATING SYSTEM; J. H. Fedeler, Schenectady, N. Y. App. filed Dec. 6, 1902. Air is directed through the motor casing for cooling purposes and then led into the car for heating purposes.

721,882. TELEPHONE SYSTEM; S. B. Fowler, Morristown, N. J. App. filed November 5, 1900. (See page 445.)

721,939. LIGHTNING-ARRESTER; W. J. Chapman, Minneapolis, Minn. App. filed April 19, 1902. (See page 445.)

721,942. ELECTRIC SWITCH SYSTEM; A. L. De Leeuw, Hamilton, Ohio. App. filed Nov. 24, 1902. A switching system adapted especially for planing machines to feed the tool after each stroke of the table.



722,066.—Automatic Rail Gripping or Locking Device for Electric Cranes.

721,981. ELECTRICAL CASH REGISTER; J. C. Vahjen, New York, N. Y. App. filed May 9, 1902. The various functions of a cash register are performed electrically upon the pushing of a key and rotation of a crank as in the mechanically operated machine.

722,021. TELEPHONE-TRANSMITTER; C. Holmok, Cleveland, Ohio. App. filed February 21, 1902. (See page 445.)

722,024. SWITCH; J. N. Kelman, Colgate, Cal. App. filed Jan. 30, 1902. A high potential switch in which one terminal is placed in a vessel filled with thick layers of oil and water, the other terminal being passed through the liquid to make and break contact.

722,030. APPARATUS FOR MEASURING AND INDICATING ELECTRICITY SUPPLY; C. H. Merz, Westminster, Eng. App. filed Sept. 25, 1902. An integrating meter and an indicating device driven from the meter and adapted to indicate the greatest amount of current integrated by the meter during any one of a number of intervals of time.

722,036. TROLLEY STAND; W. B. Norton, Detroit, Mich. App. filed May 26, 1902. Details of construction.

722,042. ELECTROMAGNETIC MOTOR; A. P. Y. Aguirre, Havana, Cuba. App. filed Aug. 28, 1902. Details.

722,066. AUTOMATIC RAIL GRIPPING OR LOCKING DEVICE FOR ELECTRIC CRANES; S. T. Wellman, and J. E. A. Moore, Cleveland, Ohio. App. filed March 18, 1902. A magnet controlling the rail gripping device is in circuit with the motor of the train, so that when the motor is cut out, the rail is automatically gripped.

722,109. RAILWAY SIGNALING APPARATUS; H. J. Jefcoate, Crewe, Eng. App. filed Nov. 24, 1902. Automatic apparatus for displaying signals in the cab of a locomotive.

722,139. SELF-DECOHERING COHERER SYSTEM; A. Popoff, Cronstadt, Russia. App. filed March 8, 1900. (See Current News and Notes.)

722,189. TROLLEY WHEEL FOR ELECTRIC TRAM CARS; A. Selz, Flemingsburg, Ky. App. filed Nov. 14, 1902. The wheel has an elongated axle, along which it can slide against spring pressure when the car is passing a curve.